NOTES ON RECENT OPERATIONS

GENERAL PRINCIPLES
CORPS AND ARMY OBSERVATION
PURSUIT
DAY BOMBARDMENT
BALLOONS

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NOTES ON RECENT OPERATIONS

COMMENSURATION
CAMPAIGN AND OPERATIONS
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[Signature]

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NON-CIRCULATING
The following has been copied from a proposed manual prepared under the direction of Col. E. S. Gorrell, Assistant Chief of Staff, A. S., A. E. F., but not yet approved by General Headquarters, up to April 11, 1919, when a copy was sent to the United States in response to cables. This appears to be a final revision of the first draft entitled "Tentative Manual for the Employment of Air Service."

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PART I.

CHAPTER I.-GENERAL PRINCIPLES.

1. The name Air Service is, to some extent, a misnomer; the employment of air units is not an automatic thing, functioning as a service, but is the use of an arm subject to the same variety of combinations for differing tactical situations as are the other combat arms, and governed by the same tactical principles. It is proposed, therefore, to enumerate these principles, before going into a more detailed study of Air Service employment.

2. For man to fear man more than the chance action of steel and lead is a fundamental of human nature. Therefore, in the future, as in the past, the final decision in war must be made by men on the ground, willing to come hand to hand with the enemy. When the Infantry loses the Army loses. It is therefore the role of the Air Service, as well as that of the other arms, to aid the chief combatant, the Infantry. That the lack of assistance from other arms would inevitably result in the defeat of our Infantry does not affect the truth of the axiom. Two important corollaries therefore follow: The Air Service must know Infantry and its assistants; and general officers and their staffs cannot hope to produce the most efficient tactical combinations, unless they have a thorough knowledge, not alone of Infantry, but of its assistant arms, which include the Air Service.

3. In so far as the Army is concerned, the object of war is the defeat of the enemy's armed forces in the field. This can be done only by seeking a decision in battle. It is essential to victory, therefore to assume the offensive. In war practically never does victory come as a result of the material destruction of any large portion of the enemy's forces. Often such material destruction has resulted from victory; it has never been a prerequisite to victory. The final aim sought, therefore, is not the material destruction of the enemy, which can never in practice be even nearly
complete, but the destruction of the enemy's hope of victory, of his desire to continue fighting—in a word, of his morale. This fact must be particularly borne in mind in considering the Air Service, whose moral effect on ground troops is out of all proportion to the material destruction wrought. In the line, the most certain outward sign of that superiority of morale which insures victory is the possession of the battlefield. No other factor is so largely destructive of the enemy's morale as this. It has been truthfully said, therefore, that to advance is to conquer, and one may conquer only by advancing. These facts, seemingly trite, must nevertheless be constantly kept in mind. Whole tactical doctrines have ignored certain of these truths, with consequent disaster. Men were not appreciating the very nature itself of war. In the future, then, resolve itself into an attempt, by a crushing blow, to destroy but a limited portion of an enemy's army while holding over the remainder the threat of impending destruction. This demands, therefore, a certain economy of forces; to the portions of the field where the blow is to be struck must be brought the superiority of force needed. For all other portions of the field we may regard troops there employed as detachments—either to hold limited portions of the field or to ascertain the enemy's strength.

4. It is the battle, then, that is sought for, and, in the battle, the destruction of the enemy's morale. It is not necessary, however, at one and the same time to attack all portions of the hostile army. The morale of an army may be compared to the human body: to destroy it, it is necessary to destroy only one of several of its component parts. The battle, therefore, as in the past, the only true expression of war is the battle, and the battle implies and necessitates movement. The long deadlock on the western front must be regarded as exceptional and peculiar, and the lessons drawn from that carefully examined, lest a rule be deduced from what was indubitably an exception.

5. Before, however, the proper economy of forces can be determined, knowledge must exist of the enemy's dispositions. In former wars this required numerous detachments of troops. The employment of these constituted the preparatory stage of the battle, which frequently absorbed a large portion of the forces available. Great tact and coolness, a careful estimate of facts still left, often, no lightening of the "fog of war." It is in this phase of the battle that the relative importance of aircraft has steadily grown. Physical factors alone can now prevent flying: (a) Lack of visibility, and (b) high winds at night. A pilot, traveling at rates of speed almost always in excess of 100 miles per hour, must have a fairly wide range of vision in order to know and to maintain his course. Nor can visibility be determined from ground observations, except in extreme cases. It is highly probable that, with time, this handicap will be largely overcome. It must, however, be accepted as a definite limitation to-day. A second limitation to be borne in mind is the duration of time an airplane may remain over the enemy lines. Owing to the question of fuel supply, wear and tear on comparatively delicate engines, and the great physical and mental strain of flying, where every sense is keyed up to the highest, only a small average number of hours per day per plane available can be kept up indefinitely. It is not uncommon among the uninstructed to believe that because 10 planes are available 10 may be kept over the lines all day, with short intervals for replenishing fuel. Such is far from being actual service conditions.

6. The decisive blow struck, to complete the victory requires that the fleeing enemy be given no opportunity to reorganize, and that his loss of morale be communicated to the portions of his army still unstruck. The pursuit, then, is at once organized. Too frequently in past wars the victor, scarcely less disorganized than the vanquished, has failed to gather in the fruits of victory. Very rarely has a thoroughly organized pursuit been possible. This problem will be dealt with in greater detail in a later chapter, so far as the employment of aircraft is concerned.

7. The general principles briefly outlined above apply to Air Service units not alone in active cooperation with ground troops, and their attack on the enemy's ground troops, but equally in purely aerial warfare. Before, however, discussing in detail tactical use of aircraft, certain possibilities and limitations of aircraft must be considered.

8. The extraordinary development of airplanes during the Great War has brought it about that practically two natural factors alone can nowadays prevent flying: (a) Lack of visibility, and (b) high winds at night. A pilot, traveling at rates of speed almost always in excess of 100 miles per hour, must have a fairly wide range of vision in order to know and to maintain his course. Nor can visibility be determined from ground observations, except in extreme cases. It is highly probable that, with time, this handicap will be largely overcome. It must, however, be accepted as a definite limitation to-day. A second limitation to be borne in mind is the duration of time an airplane may remain over the enemy lines. Owing to the question of fuel supply, wear and tear on comparatively delicate engines, and the great physical and mental strain of flying, where every sense is keyed up to the highest, only a small average number of hours per day per plane available can be kept up indefinitely. It is not uncommon among the uninstructed to believe that because 10 planes are available 10 may be kept over the lines all day, with short intervals for replenishing fuel. Such is far from being actual service conditions.

9. From the point of view of command, the greatest value of the Air Service to date has been in gathering information of the enemy and of our own troops. In future wars, this source of information should be both more nearly complete and more reliable. The observer, aloof from the battle, is less subject than others to its disturbing influences. He is removed from the contagion of fear and panic, so easy of transmission where men are elbow to elbow. He hears none of the reports of the wounded, nearly always breathing calamity. He receives no impressions from skulkers, "the last man left in the company," justifying their crime by reports of disaster. In short, he is physically so situated as to be able to see and report with an approach to that mathematical coolness and accuracy that is so desirable, but so seldom secured by human beings in the thick of a fight, subject to all its disturbing reactions.

Physically, nothing is deflected from the airplane observer's view, a situation that is rarely met with in even the best systems of terrestrial observation.

During the long period of trench warfare, elaborate methods of liaison were established, which seldom succeeded when the war of movement—which alone is really war—began. Liaison from airplane to ground, less modified by movement because more simple and containing fewer links to be broken, should, on the contrary, always be successful in open warfare, where due care is taken. Liaison from the ground to the airplane, on the other hand, is still comparatively undeveloped, and constitutes one of the problems of the immediate future.

Reports from untrained observers, whether on the ground or in the air, are generally valueless. Training is essential
before one can describe the location of the most conspicuous objects. To know what things are important, and what unimportant; to know exactly what to look for, and what negative information is of value—in short, to secure from a view of the field such information as will permit an accurate estimate of the situation; all this requires an officer whose knowledge and intelligence fit him to be a general staff officer. In practice, this ideal will rarely be attained. Nevertheless it will be striven for, and this effort will render more full and reliable the information received in future from the Air Service.

10. An employment of the Air Service as yet in its infancy, but capable of great results, is that of actually intervening on the battlefield, not alone by bombing but also by direct attack with machine guns. In estimating the value of such attacks, we must again bear in mind that an army is defeated not by destroying it, but by destroying its morale. It has been said before that man fears man more than the chance of lead or steel. The basis of the greater fear is the knowledge that man, having both intent and intelligence, can pursue his design to a fatal conclusion, and hence is more terrible than any inanimate object directed from a distance. Much of this feeling enters into man’s fear of hostile airplanes. The airplane’s commanding position, rendering concealment apparently useless, induces the instinctive belief in the heart of every man on the ground that he himself is being watched by hostile eyes and being made the target for bomb or bullet and that this hostile man can pursue him intelligently and ultimately destroy him. To this is added a feeling of utter helplessness, not justified by facts, but none the less instinctive and not to be wholly overcome by reason or training. That the moral effect of attacks from the air is, as compared with attacks from the ground, out of all proportion both to the effort expended and the material damage done, is attested by many incidents. A division of first-class troops that received with equanimity 4,000 shells per day in its sector has been known to be greatly disturbed and harassed by the efforts of one persistently active day bomber. Inquiry showed that almost every man in the division believed himself to have been in danger from this plane.

11. It is intended to set forth herein the principles governing the use of air units, and to put on record the results of experience in this war. But two facts must be held constantly in mind: The Air Service is a combatant arm, and full training in peace can alone prevent inefficiency in war.

CHAPTER II—SECURITY.

12. Security, in all Air Service units, as in all branches of the Army, embraces all those measures taken by a command to protect itself from observation, annoyance, or surprise by the enemy. Security of the plane in the air will be dealt with under the heading of “Combat,” because in reality once the machines have actually left the airdrome, the general principles of combat go hand in hand and come within the province of fighting in the air. It will be necessary only, therefore, in discussing the security of Air Service organizations, to consider these measures taken by the commanding officer at his airdrome, for protection from observation, annoyance, or surprise.

13. It is essential that the greatest care be exercised in selecting an airdrome, not only from the standpoint of accessibility, shelter, and other general principles, but also from the standpoint of security. Airdromes, if possible, should be away from landmarks visible at night; they should be away from streams; if located at the edge of a forest, they should not be near a prominent portion of it. While it is well in selecting an airdrome to take precautions against enemy action, it is advisable to look out for natural obstacles, such as undulating ground, and high objects which might endanger machines landing or taking off. Every precaution should be taken that will eliminate, in so far as possible, the chances of accident. In flying, accidents are bound to occur, especially at the front, where pilots are expected to fly even under adverse conditions. After the airdrome has been located, care should be used in the location of the hangars. The distance between hangars should never be less than 100 yards, and in practice it has been found well to scatter them evenly around the perimeter of the field. Where there is danger of night bombing it is well to camouflage the hangars in order that they may not stand out as landmarks at night.

14. Complete mobility of all units insures the safety of material when a general retreat becomes necessary. This mobility depends principally on sufficient initial transportation equipment, and its proper upkeep during the course of operation, and on the maintenance of mobility in the unit at all times. Offices should be located in trailers, ready to be pulled away on a moment’s notice. Spare
parts should be kept in trailers and in spare trucks, and movement orders should be accessible at all times, and revised and republished at frequent intervals.

CHAPTER III.—SHELTERS.

15. The maximum achievements of any Air Service organization can be secured only when machines are properly housed against the weather and the personnel is comfortably cared for, yet mobility and defense against bombardment attacks must be considered.

16. Airfield sites should be selected on flat, well-drained high ground, as free as possible from mud and dust. Good roads must lead to them and a railroad should pass in the vicinity. High grass will injure many propellers. It must be removed before flying begins. Sanitation and kindred needs will be cared for as prescribed in Field Service Regulations.

CHAPTER IV.—ORDERS.

17. The principles laid down in Field Service Regulations for the issuance of orders apply to the issuance of orders for the Air Service.

CHAPTER V.—MARCHES AND CONVOYS.

18. (a) Wings or larger units will move by groups.

(b) The removal of a pursuit group from one field to another has primarily three phases:
   I. Preparation for the move.
   II. The move.
   III. Arrival at the new airfield and the preparation until the day of attack.

19. Preparation for the move.—(a) As accuracy is of paramount importance in any move, the group commander will be given his new location and all necessary information concerning it, with instructions to make all arrangements to move, but to carry on his preparations fully, with only the date, hour, and location omitted.

(b) He will, therefore, immediately before flying to the new location, call a meeting of squadron commanders, park commanders, supply, transportation, radio, engineering, and any other officers who in his opinion are needed to contribute to the working out of the operation, which must be planned with all the forethought possible. In this meeting all questions of moment will be discussed, including:
   I. Transportation.
   II. Supplies—continuance of incoming supply.
   III. Rations for at least 10 days from the present railroad.
   IV. Material left on the field for transport to the rear, to be placed in charge of an officer sent from the rear for that purpose.
   V. Billeting to be properly adjusted with the local authorities before leaving.
   VI. Pulling down of existing intercamp lines of communication installed by the group.
   VII. Thorough policing of the camp before leaving, etc.
   (c) The group commander will then make an aerial reconnaissance to the new airfield, with the purpose of returning with maps, photographs, and data of importance in the move.
   I. He will establish the route by which pilots will fly, noting the important landmarks, airfields, gas stations, headquarters to notify if forced to land on one side or the other of given points en route. He will have inspected the new field and made notes on:
      II. The landing facilities.
      III. The work of the construction squadron engaged in the preparation of the field and upon the construction of barracks, hangars, etc.
      IV. The line of communication to outside headquarters.
      V. The disposition of the hangars on the field and assignment of squadrons to occupy them.
      VI. The new group headquarters and the most suitable location thereof.
      VII. Men's quarters and messes.
      VIII. Officers' quarters and messes.
      IX. And in general the disposition of the neighboring units and ways in which they might be of assistance to his command in moving in.
   (d) Upon returning to the old field, he will see that all these details are passed on to the squadron commanders and to those affected.

20. The move.—(a) Moving orders will be received from the wing or the Army Air Service commander, depending upon the tactical use to be made of the unit. They will be acknowledged by notifying the headquarters as soon as the echelons have all started.

(b) The move will be made in four echelons, by squadrons, each echelon of each squadron in charge of an officer:
   I. Advance echelon.
   II. Main echelon.
   III. Flying echelon.
   IV. Rear echelon.

21. The advance echelon will be in charge of a competent officer and will be light, consisting only of the personnel necessary to start intercamp communication by telephone, to establish squadron operations, to locate sources of supply, fuel, straw, water, etc., and to set up kitchens to take care of arrivals until incoming units are settled. In regard to these matters, the park commander will immediately get in touch with the air depot of the Army or its advanced field to insure this supply, determining, at the same time, the quantity of planes on hand, spare parts, etc., that may be called upon for immediate use, and will get in touch with parks of adjoining armies which may be used as auxiliary supply.

22. The main echelon will leave, if possible, the next day. It will consist of all nonflying personnel of the group, less the personnel from squadrons and headquarter's detachment required to provide meals, start planes, make minor repairs on those planes which may be out of commission, attend to billeting, policing, etc. All material that can be taken will accompany this echelon, which will leave camp at the designated hour and will follow the route according to itinerary.

23. The following rules and regulations are to be observed on the march:
   (a) All stops for meals or other reasons, other than caused by emergency, will be regulated on schedule order issued when moving order has been received, designating time of departure and route,
(b) Speed of truck train will be between 10 and 12 miles per hour, regulated by acting first sergeant at head of train, in side car.

c) In towns and villages, distances between transportation will be 30 feet, elsewhere, 200 feet.

d) The train will never stop within a radius of 1 mile of any town or village.

e) No soldier will descend from trucks for any reason whatsoever without permission from the noncommissioned officer in charge of truck.

(f) Each noncommissioned officer will be in close relation with his senior noncommissioned officer and privates, directly responsible to his immediate superior for the discipline and work of his men.

g) When train is moving, if certain trucks are lagging, they will be put at the head of the train.

(h) Trailers may be shifted at noon stops or at evening stops, provided that such changes will assist in maintaining schedule.

(i) Chauffeurs will work in details to which trucks are assigned and will be held responsible that their respective trucks have extra supply of gas.

(j) The noncommissioned officer in charge of each section will be responsible to the acting first sergeant for the loading and unloading and placing of equipment assigned to his section. He will be responsible also for the discipline of the men assigned to his section while en route and until the squadron is settled in its new quarters.

24. The flying echelon will consist of all serviceable machines, with their pilots. This party will leave the field after the advance echelon has reached its new station to receive the planes. Flight formations will be used and each pilot leaving the ground will be given the information necessary for making the trip. On arrival at the new station, each pilot will report to the commander of the advance echelon.

25. The rear echelon will consist of the personnel required to provide meals, start planes, make minor repairs on those planes which may be out of commission, attend to the billeting, policing, care of material left on the field for transport to the rear, empty gas containers, etc. They will terminate their work as quickly as possible, making sure that the camp is thoroughly policed and in the proper shape to be taken over by the rear units or a new organization, and leaving a proper guard for the camp, should the incoming units be delayed or the local authorities be unable to furnish proper protection.

26. It is most important that these echelons be properly officered to handle any emergencies that might arise, and that the move be conducted according to one prescribed route, with a schedule of arriving and departing times for the main stopping points en route.

27. Officers heading these echelons will each be assisted by another officer in a side car, who will bring up the rear and notify the head of the convoy of any breakdowns. They will also be informed on all traffic rules for convoys; see that all rules of the road are observed, and in entering congested areas will make sure that no other moving units have priority of movement.

28. All drivers will be supplied with maps and an itinerary of the move, for the event of breakdowns.

29. Each echelon will depart with 10 days' ration.

30. A medical officer will accompany each echelon.

31. Arrival at the new field and preparation until the day of the attack.—As soon as the group has arrived, the group commander will:

(a) Report arrival, in person, to the wing or to A. A. S. C. headquarters, as the case may be.

(b) Ascertain the locations of all units with which he will be expected to keep in liaison.

(c) Dispatch the radio and searchlight officers to establish relations with the radio and searchlight P. C.'s and to get in touch with their respective liaison officers at A. A. S. C. headquarters.

(d) Dispatch liaison officers, calling upon squadron commanders, if necessary, to establish relation with anti-aircraft batteries, balloon locations, headquarters of adjoining Army units, corps observation groups, or pursuit groups; in short, developing all sources of information which will materially assist in the efficient functioning of the group, as well as developing relations, which will include the personal touch so essential in cooperation.

(e) See that all lines from outside sources, as well as the intercommunicating telephone systems, are speedily installed, as also radio and searchlight installations.

(f) Make sure that the operations office of the group is establishing itself, with all scale maps necessary, information about existing lines, locations of allied and enemy airfields, antiaircraft batteries, balloon locations, searchlight locations, etc., and the proper housing of the radio and power equipment.

(g) Make arrangements for an aerial target, preferably a small lake, at which the pilots may commence at once to test their guns.

(h) Visit personally the staff officers of the A. A. S. C., or wing, of the Army to which attached; corps observation groups, pursuit groups with whom patrols will be made; C. O.'s of units working with the Army operation on the right or left, etc.

32. Separate squadrons will move as above, except that the aerial reconnaissance of the new station and other details of the group commander's duty will be performed by the squadron commander.

33. A separate flight will generally move in only three echelons: The advanced echelon, the flying echelon, and the rear echelon. The main body of the flight may travel with either the advance or rear parties, depending on circumstances. The flight commander will make the same arrangements as the group or squadron commander in the moves discussed above.
PART II.—CORPS AND ARMY OBSERVATION.

INTRODUCTION.

34. The purpose of these notes is to establish, on the basis of experience gained in the war with the Central Powers, the general lines of tactical procedure governing the operations of the Air Service assigned to Army corps in the field.

CHAPTER I.—GENERAL PRINCIPLES.

35. As with the Air Service as a whole, the Air Service of an Army corps in the field is an auxiliary combat arm, organized primarily for the purpose of observing the dispositions and activities of the enemy during active hostilities, and serving as a means of liaison between troops of the command. It further assists the Artillery as a means of fire control. It partakes of the general nature of other combatant arms in that its mission forces it from time to time into combat with enemy aerial forces. The Corps Air Service may accept but will not ordinarily seek combat.

36. The Air Service of an Army corps is under the tactical and administrative control of the general commanding the Army corps. The troops of the Air Service of a corps are corps troops. Corps Air Service troops assigned for tactical duty to divisions within the corps retain their identity as corps troops.

37. The basis of organization for the Air Service of an Army corps is the Aero Service Observation Squadron for the "heavier than air" work and the Balloon Company for "lighter than air." The basis of the squadron is the two-seater airplane, manned by a pilot and an observer. The Air Service of the corps may consist of one or more squadrons and one or more balloon companies.

38. When two or more squadrons are operating together in the same corps they are organized into an observation group.

The observation group is under the immediate command of a group commander. Balloon companies assigned to a corps are organized into a corps balloon group under a balloon group commander whose headquarters are ordinarily in connection with the C. A. S. C. at corps headquarters.

39. The tactical and administrative control of the Corps Air Service vested in the corps commander is delegated to a Corps Air Service commander (C. A. S. C.). The C. A. S. C. is an officer of the Air Service. He is a member of the corps staff. Upon the original organization of the corps the is designated by General Headquarters upon the recommendation of the Chief of Air Service. Thereafter the corps being a part of an army, he is designated by the commanding general of the army upon the recommendation of the Army Air Service commander.

40. The Corps Air Service is dependent for technical supply and replacement of personnel upon the Air Service Organization of the Services of Supply, operating through the medium of air depots, air parks, and replacement squadrons of the Air Service in the zone of advance.

41. The details of organization, assignment, and designation of personnel, amounts and kinds of transportation, and technical equipment, are fixed in the Tables of Organization for the Air Service of an Army Corps, Air Service of the United States Army.

CHAPTER II.—THE SQUADRON.

42. Tactical and administrative control of the squadron is vested in the squadron commander. He is responsible for the tactical, technical, and administrative efficiency of his organization. He is assisted in the discharge of his duties by a staff of officers. His prime qualification is leadership. He is the rallying point of his command. The degree of success attained by the squadron will depend very largely upon the example set by the squadron commander. The squadron commander may be either a pilot or an observer. In either case he is conversant with the essential principles of the work of both.

43. A squadron commander in his administered duties is assisted by a competent adjutant. Routine administration is supervised by the squadron commander, but is effected by the adjutant.

44. Routine details of squadron supply are administrated by the supply officer. The supply officer will ordinarily be placed in charge of the transportation of the squadron.

45. In the exercise of his tactical functions the squadron commander is assisted by an operations officer. This officer is ordinarily the senior observer present. A junior observer may be detailed as operations officer if, in the opinion of the squadron commander, his executive ability, practical experience, and record for devotion to duty warrant his preferment. The operations officer is responsible, under the squadron commander, for the direction of the tactical operations of the squadron. He collects, compiles, and transmits all tactical information. He assigns tactical missions to the individual pilots and observers of the squadron. He directs the establishment and maintenance of liaison. He prepares nightly, to be sent to higher authority, a detailed account of the tactical operations of the squadron for the day. He acts as tactical advisor and instructor to the pilots and observers of the squadron.

46. The operations officer is assisted in the discharge of his duties by an assistant operations officer. The assistant operations officer is an observer. The assistant operations officer replaces the operations officer during the latter's absence.

47. The squadron is equipped with a radio set capable of sending and receiving radio messages to and from all ground stations within a radius of 50 kilometers. The squadron radio set is further equipped with an artillery spark set for receiving airplane messages on short wave lengths. The squadron radio equipment consists further of airplane type sending sets mounted on each airplane. A detail of radio mechanics is a part of the personnel of the squadron. The Squadron Radio Section is in charge of the radio officer. The radio officer is responsible for the installation and upkeep of all radio equipment. He is responsible further for the radio liaison of the squadron. He is in personal touch with the corps and Army radio officers. He is conversant with corps and Army radio plans and regulations and
assures compliance with these. He assigns wave lengths to outgoing airplanes. He is responsible for the coding and decoding of radio messages and of telegrams. He receives the test calls of airplanes leaving the airdrome, unless relieved of this function by the radio officer of a higher unit. He investigates the causes of airplane radio failures and establishes liaison with radio stations of artillery and other units in relation with which radio failures have been reported. Wherever possible he logs the messages of all airplanes of his squadron operating on the lines, with a view of determining, in case of failure, whether the faulty functioning originated aboard the airplane or elsewhere. He maintains a complete log of all radio messages received at his station. He is assisted by one or more noncommissioned officers trained in radio work.

48. The armament of the airplanes of the squadrons is installed, aligned, and maintained at the maximum of efficiency by the armament officer, assisted by a staff of enlisted mechanics. The armament officer is responsible for the supply, calibration, and loading of machine-gunn ammunition. He is further responsible for the supply of signal rockets, signal pistols, and message-dropping tubes. During intensive operations he is charged with the duty of replenishing, aboard each airplane, immediately the plane is announced available for flight, the stock of equipment above-noted. Immediately upon taking station at an airdrome the armament officer establishes a machine-gun testing butt, an armament workshop and storeroom, and erects adequate gun racks. He assigns rear-turret machine guns to observers by number. He assures the use of rear-turret machine guns only by the observer to whom each gun, or set of guns, is assigned.

49. A squadron is divided into three flights, each under its flight commander; the flight is composed of six airplanes, together with the indicated proportion of pilots, observers, and mechanics. The flight commander is ordinarily a senior pilot, and never an observer. The flight commander is responsible to the squadron commander for the upkeep and maintenance of the airplane and other property assigned to his flight, for the training and discipline of his pilots and observers, and for the proper execution of all missions assigned to his flight. The flight commander will see that all missions are executed promptly and that the results are promptly reported. He will be responsible for the discipline, training, and proper performance of all duties of the enlisted men in his flight.

50. The engineer officer is the representative of the squadron commander, and as such will make the necessary inspections of the airplanes in all flights, reporting to the flight commander concerned any suggestions or recommendations relative to his airplanes. In case the proper remedial measures are not taken by the flight commander, it is then the duty of the engineer officer to report the fact to the squadron commander. The adjutant, operations, engineer, and supply officers are all staff officers of the squadron commander and are simply the means for carrying out, in their various departments, the details of the work of the squadron. Orders for flights will regularly be given through the flight commanders. In case he has to be absent, the squadron commander will designate a flight commander to take command of the squadron.

51. Where a single squadron is operating separately with a division in the field the tactical organization becomes similar to that of the Observation Group.

CHAPTER III.—THE CORPS OBSERVATION GROUP.

52. The Corps Observation Group consists of a headquarters, two or more observation squadrons, and a photographic section. Medical, Ordnance, Artillery, Infantry, and Intelligence personnel are attached. The Corps Balloon Group and its companies are part of the Corps Air Service, and as such the balloon group commander is directly under the orders of the Corps Air Service commander.

53. Command of the group is vested in the group commander. The administrative functions of the group commander are similar to those of the commanding officer of an Army post.

54. The group commander assures the efficient execution of tactical orders received from higher authority. He is responsible for the organization and efficiency of the tactical staff assisting him in his functions. In reality he is the representative, at the airdrome, of the Corps Air Service commander. Upon his ability to visualize the specific demands of the general situation as communicated to him from higher authority depends the success of the group.

55. The group commander is assisted in his administrative work by a group adjutant. The adjutant is assisted in his duties by a headquarters detachment of enlisted clerks and orderlies. The functions of the adjutant are similar to those of the adjutant of an Army post.

56. Supplies are received by the group from the air park and also the air park attends to certain repairs of not sufficiently major importance to warrant their being done at the air depots.

57. In the fulfillment of his tactical functions the group commander is assisted by an operations officer, usually an able and experienced observer who is responsible, under the group commander, for the direction of the tactical operations of the group. This operations officer collects, compiles, and transmits all tactical information proceeding from outside sources to the group and all information proceeding from the group to outside units and headquarters. He transmits orders for the execution of missions to the squadrons concerned. He actively directs and maintains at a high point of efficiency the liaison of the group. He organizes the group operations room. He prepares the schedule of missions for each day. He renders nightly to higher authority a detailed account of the tactical operations of the group for the day. He receives and supervises the reports of all observers. He acts as tactical adviser and instructor for the flying personnel of the group.
METHOD of FORMING FIVES or MULTIPLES

Drafted by: A. J. G. Scott, Sh. I. C. T. C. (U. S. Marine Corps)
58. The operations officer is assisted in the discharge of his duties by an assistant operations officer.

59. The radio section of the group is exactly similar in organization to that of the squadron. The group radio officer, in addition to the duties outlined for the squadron radio officer, supervises the operations of the squadron radio sections. Where a separate radio section is not detailed to the group the group commander may designate a squadron radio section in lieu thereof. The group radio section maintains operators at the receivers throughout the day and night. It constitutes one of the surest means of liaison available.

60. A complete military photographic laboratory constitutes a part of the technical equipment of the group. The laboratory, together with its staff of enlisted experts, is commanded by the group photographic officer. Wherever possible the photographic officer is responsible for the installation of a photographic barrack, with complete apparatus for developing, drying, and printing in quantity production. Airplane cameras are a part of the equipment of the group photo section. The installation of cameras aboard airplanes is a function of the photo section.

61. The branch intelligence officer is a member of the group tactical staff. He is especially trained in the subject of intelligence of the enemy. He is assisted by a staff of clerks, draftsmen, and photographic interpreters. He is responsible for the collection, compilation, and distribution of all intelligence of the enemy gathered by the observers of the group. He provides the maps for the use of the group. He prepares a special large scale mimoographed map for use of observers in marking the location of troops. These maps are extremely useful additions to dropped messages reporting the results of infantry contact patrols. He is responsible for the interpretation, assemblage, map and file record, and distribution of aerial photographs of enemy territory secured by observers of the group. He maintains close liaison with G-2 of the corps. It is desirable that the branch intelligence officer be competent in artillery work and that he be familiar with the functioning of the counterbattery office of the corps. In addition to his close liaison with G-2, he should be in close touch with the corps counterbattery office. By his intimate knowledge of the observing personnel of the group, he can estimate the value of every report containing information of enemy artillery action.

62. The operations room is the tactical heart of the observation group. It is the center and source, for the organizations and individuals of the group, of all tactical information. In it are conveniently displayed detailed large scale situation maps of the organization of the army, corps, and divisional areas. Other maps show enemy situation and organization. Charts, diagrams, tabulations, orders, bulletins, reports, and photographs having a technical or tactical bearing on operations are available for immediate access. Worktables, paste pots, and colored crayons for the use of observers and pilots are provided. Maps are on file for distribution to individuals. A collection of technical works for reference by the flying personnel is kept at hand. The complete operations room is the realization of effective liaison. Before leaving on missions, observers are instructed to post themselves on the latest developments and to receive final instructions from the operations officer, or his assistant at the operations room. Upon returning from missions, observers invariably prepare their reports here. The operations room is the headquarters of the operations officer.

CHAPTER IV.—THE CORPS AIR SERVICE COMMANDER.

63. Technical, tactical, and administrative control of all sections, units, and groupings of the Air Service of Army corps is vested in the corps Air Service commander. The C. A. S. C. is a field officer of the Air Service. He may be either a pilot or an observer. He should be thoroughly familiar with the general principles of procedure governing the operations of the General Staff. He is a member of the corps staff. In addition to his administrative and tactical duties as an Air Service commander, he is the immediate adviser to the commanding general and the staff in all matters pertaining to the tactical employment and operations of the Air Service as a whole. He is at all times familiar with the tactical situation and may make such dispositions to meet it as the limitations and possibilities of the arm he directs indicate, provided that such dispositions in no way conflict with instructions emanating from superior commands. He further transmits and assures compliance with orders governing the employment of the Air Service emanating from the staff and the commanding general. He is responsible for the efficiency of Air Service liaison. He is responsible for the assurance of maximum operative efficiency of the units and staffs of his command. He is assisted in the discharge of his duties by a staff of experienced Air Service officers. The post of the C. A. S. C. is with the corps staff. The office of the C. A. S. C. is a section of corps headquarters.

64. The C. A. S. C. is assisted in his administrative duties by an adjutant. The adjutant is assisted by a headquarters detachment of enlisted clerks and orderlies.

65. Adequate transportation and transportation personnel must be allotted the C. A. S. C. for the carrying out of all liaison duties and establishment of courier services. Supervision of transportation is ordinarily a duty of the adjutant.

66. The C. A. S. C. is assigned an airplane for his personal use. It is a function of one squadron of his command to assure the care and upkeep of his airplane.

67. In the discharge of his tactical duties the C. A. S. C. is assisted by an operations officer. The operations officer is an Air Service observer of wide active experience and considerable executive ability. The operations officer replaces the C. A. S. C. in his temporary absence. He is responsible, under the C. A. S. C., for the issuance and transmission of all tactical orders. He advises with the C. A. S. C. in all matters pertaining to the establishment of an efficient system of liaison and assures the accomplishment of adequate liaison by all sections, units, and groupings of the corps Air Service. He collects, compiles, and transmits, in close liaison with the corps and divisional staffs, all information, both outgoing and incoming. On the basis of the tactical situation as established by the day's information and orders he prepares, under the immediate supervision of the C. A. S. C., the general operations order governing the operations of the group for the following day.
ANOTHER METHOD
OF FORMING

Drafting Sec. Air Service Wash. D.C.
The operations officer of the C. A. S. C. is assisted in the discharge of his duties by an assistant operations officer.

Such personal liaison for the office of the corps Air Service as can not be undertaken by the C. A. S. C. or his operations and assistant operations officer is assured by one or more liaison officers. These officers are ordinarily Air Service observers of considerable active experience. It is their duty to visit as often as may be necessary the headquarters and posts of command of divisions and divisional troops and there discuss and, if possible, solve all tactical problems and collect all tactical information having a bearing on the operations of the Air Service in their relation to the commands visited. Liaison officers render verbal and written report of their activities to the C. A. S. C. at the close of each day.

It is important that all concerned recognize the office of the corps Air Service commander as the sole controlling point for activities of the corps Air Service. However, when a squadron is assigned to work with divisions it becomes divisional Air Service and the division commander has complete control of it. Ordinarily no orders emanating from staff or line commanders requiring compliance by units of the corps Air Service will be transmitted direct to the group or to the squadron immediately concerned. Orders will be transmitted to the C. A. S. C. or his representative and thence will be issued to lower units. Situations may and frequently do arise where it is impossible to transmit through the office of the C. A. S. C. orders for the Air Service having their source in divisions. Communication may be interrupted or extreme urgency may interfere and may dictate the more direct and rapid method. In special situations of this nature it is permissible for divisions to transmit orders direct to the group. The C. A. S. C. in this case is informed by the group commander of the receipt of orders and the action taken to comply. In like manner all relations of the group and squadrons entered into with line organizations should be taken cognizance of by the C. A. S. C. Liaison officers proceeding to division headquarters and divisional units will report to the C. A. S. C. that visits are contemplated or have just taken place. The results of visits will likewise be reported. It is of extreme importance that the C. A. S. C. be informed up to the minute of all tactical activities of his command. Obviously, unless he is conversant with the very latest data regarding the operations of his command, he can not intelligently direct future operations nor report accurately on the accomplishment of work. Incomplete exercise of control by the C. A. S. C. will result either in duplication and the issuance of superfluous orders, or in an under-estimation of the needs of the situation and a consequent failure to make adequate disposition.

CHAPTER V.—ASSIGNMENT AND FUNCTIONS OF SQUADRONS.

In assigning squadrons the C. A. S. C., upon whom this duty devolves, will consider the tactical needs of the corps as a unit and the needs of the divisions of the corps in the line. Excepting for purposes of training, the division in reserve will not be considered. The C. A. S. C. will ordinarily assign one squadron to perform the missions required by the corps as a whole and one squadron each to the divisions in the line.

The corps squadron has a zone of action bounded on the right and left by the corps boundaries. The depth of the zone is ordinarily never more than 10 kilometers into enemy territory. The depth is determined in each particular situation by the relative strength of enemy aerial defenses, weighed against the urgency of demand for information. The corps squadron is charged with the duty of securing all photographs of enemy territory requested by either corps or divisions. It is charged with such general surveillance of the course of battle across the entire corps front as the situation may demand. It controls and adjusts the fire of the corps artillery and observes any preparations for counterattack.

A divisional squadron is charged with the duty of surveillance of the divisional sector to a depth equal to the depth of flight of the corps squadron. It is further responsible for establishing liaison between the divisional commander and the troops in the front line by means of low-flying contact patrols. It reports the position of the enemy’s advance elements and his dispositions for defense and attack. It controls and adjusts the fire of the divisional artillery. Observations made by divisional planes and reported to divisional headquarters are repeated to corps headquarters.

CHAPTER VI.—GENERAL OBSERVATIONS AND PRINCIPLES.

The observation airplane is not designed for combat. It is charged not only with securing information but with the duty of reporting on observations. Observation planes will avoid combat wherever possible, thereby increasing their chance of returning safely to report on information gained. They will avoid all danger from enemy aerial defenses wherever such action will not materially interfere with the accomplishment of the mission. In like manner the command will carefully weigh the urgency of need for information against the risk involved in obtaining it. Where the risk overbalances the need, the Air Service will not be called into action. It must be borne in mind that the Air Service is a costly, highly-trained arm. Replacements of personnel and equipment are difficult and effective must be husbanded in times of relative inactivity in order that maximum service may be counted on when greater need arises. Airplanes must never be utilized when balloons will give the results desired. As a means of liaison between the troops and the command the Air Service should be called upon only when all other means fail or are virtually certain to fail. Never use aerial observation when terrestrial observation is sufficiently efficient. Local actions will never be deemed sufficient reason for ordering the accomplishment of contact patrols.
RIGHT ANGLE OR CROSS-OVER TURN
CHAPTER VII.—INFORMATION.

76. With the Air Service, as with all other arms, intelligent and successful action is based upon accurate and complete tactical and technical information of the military situation. The Corps Air Service itself is organized fundamentally with the object in view of gathering information as to the enemy for communication to the commands and services concerned. The Air Service, on the other hand, is itself dependent upon outside sources for such information as will enable it to carry out its functions in the most efficient manner. Collection and communication of information will constitute a prime preoccupation of commanding officers.

77. Information may be considered under two general heads: (a) Information of the friendly situation, (b) information of the enemy situation. Information of the friendly situation includes (a) situation on the ground, (b) situation in the air, (c) plans for future operations, (1) on the ground, (2) in the air, (d) liaison plans. Information of the enemy ordinarily available includes (a) situation on the ground, (b) situation in the air, (c) plans for future operations.

78. Sources of information of the friendly situation:

1. On the ground—
   Corps and division staffs, commanders of combat units.
   Field orders: G-3, Army, corps, division.
   Daily operations orders: G-3, Army, corps, divisions.
   Liaison reports: G-3, corps, division.
   Station lists: G-3, Army, corps, division.
   Situation maps:
      Artillery command, Army, corps, division.
      G-3, Army, corps, division.
   Plans of employment: Artillery, corps, division.
   Observation post bulletins: G-2, corps, divisions.

2. In the air—
   Army and Corps Air Service commands.
   Neighboring Air Service units.
   Station lists, Army Air Service.
   Bulletins, Army Air Service.
   Operations reports, Army and Corps Air Service.
   Operations orders, Army Air Service.

3. Plans for future operations—
   Field orders: G-3, Army, corps, division.
   Operations orders: G-3, Army, corps, division.
   Plans of employment: Artillery, Army, corps, division.
   Maps to accompany above: Corresponding sources.
   Air Service plane: Air Service command and units.

4. Liaison plans and data—
   Road Liaison: One-way road maps and orders, G-1, Army, corps, division.

79. Sources of information of the enemy situation:

1. On the ground—
   Field orders: G-3.
   Operations orders: G-3.
   Liaison reports: G-3.
   Observation post bulletins: G-2.
   Summaries of intelligence: G-2.
   Interrogation of prisoners: G-2.
   Enemy order of battle maps: G-2.
   Aerial photographs: G-2 and Air Service.
   Air Service reports:
      Army Air Service.
      Corps on right.
      Corps on left.
      Own corps.
   Balloon observation reports.

2. In the air—
   Enemy airdrome maps, G-2, Army (Through A. A. S. C.).
   Bulletins:
      Army Air Service.
      Corps on right, Air Service of.
      Corps on left, Air Service of.
   Operations reports, Army Air Service.
   Air Service, corps on right and left.
   Neighboring Air Service units.
   Balloon reports.
   Liaison reports, G-3.
   O. P. bulletins, G-2.
Summaries of intelligence, G-2.
Interrogation of prisoners, G-2.
Interrogation of captured aviators; Air Service, G-2.
Balloon observation reports.
Friendly antiaircraft artillery.
Observations of own Air Service units.

3. Plan for future operations:
Summaries of intelligence.
Interrogation of prisoners.

80. Stress is laid upon the personal-contact element in collecting information of every sort. Frequent conference by Air Service officers with officers of the other arms and with staff and unit commanders of corps and divisions will often bring out special information, not available from other regular sources, which may be advantageously acted upon.

81. The field order embodies a résumé of the friendly and enemy situation and establishes the strategical and tactical plan of action which will be followed by the troops of Army, corps, and divisions over a considerable period. It includes annexes giving information regarding the activities of special arms and services. The general plan for the employment of the Corps Air Service during the period of activity presumed is based upon the tactical provisions of the field order. The field order is communicated to the entire flying personnel of the Corps Air Service in order that pilots and observers may have a thorough understanding of, and take an intelligent interest in, operations in which they are to participate.

82. The daily operations order, G-3, embodies a résumé of the friendly and enemy situation at the close of the day and establishes the tactical plan of action for the following day. The activities of the Corps Air Service conform to the tactical demands for aerial cooperation with the troops as set forth day by day in the corps operations order. The G-3 operations order is not necessarily, however, the sole basis for the planning of daily Air Service operations.

83. Liaison reports, G-3, and observation post bulletins, G-2, are hurried reports rushed from the forward areas by the most rapid means of liaison available. Ordinarily they demand immediate action, if any, by the Air Service. They form the basis for the ordering of specific missions, not for the formulation of extended plans of action. They frequently warn the Air Service of radical changes in the terristrial or aerial situation requiring a reversal or readjustment of plans, an intensification of general activity, or the adoption of additional precautionary measures. Their rapid transmission from the office of the Corps Air Service commander to the group is at times of vital importance.

84. Station lists and situation maps are the basis of personal liaison. They show the location of the units with which liaison is required.

85. The plan of employment for the Artillery is the basis of the plans for the accomplishment of Air Service Artillery missions.

86. Accurate information of the strength and method of employment of neighboring friendly Air Service effective, when checked against the reported aerial strength and aggressiveness of the enemy, permits an intelligent estimate of the lengths to which corps observation may be safely carried. Knowledge of the offensive and defensive pursuit patrol schedule in the sector will permit the accomplishment of routine corps observation missions at those hours of the day when aerial support and protection is present on the lines. Dissemination of information regarding the operations of neighboring observation groups will promote interest and encourage emulation in the ranks of the flying and executive personnel.

87. Army Air Service bulletins, operations reports, and operations orders contain information of enemy aerial strength, tactics, and equipment. Army operations orders ordinarily establish, by authority of the Army Air Service commander, the broad tactical principles regulating the direction of Corps Air Service operations.

88. Personal liaison and courier runs are routed in accordance with one-way road regulations of army, corps, and divisions, established in orders emanating from the G-1 sections of the various staffs. Illustrative maps ordinarily accompany these orders.

89. The system of liaison established by the Corps Air Service is governed by the corps plan of liaison and fixed regulations above noted. Secret messages are encoded and decoded by means of the codes and keys above noted. Headquarters are called by code names in accordance with the Code Telephone Directory prescribed by the C. S. O. Map coordinates are transmitted by a system of secret lettering prescribed by higher authority.

90. Possession of information of the enemy is a prime requisite to the intelligent direction of aerial operations, permitting concentration of observation on those points where the reaction of our own forces will be most effective, or on points whence enemy activity is apprehended and where such activity may be forestalled by appropriate dispositions based upon information furnished by the Air Service.

91. Information of our own or the enemy situation having its source in the Air Service is ordinarily communicated by the C. A. S. C., direct to the G-2 section of the corps staff. G-2 is responsible for its transmission by the most rapid means of liaison available to those units concerned.

92. All information collected by officers of the Corps Air Service which has a bearing on the operations of the air services of neighboring or higher units is transmitted by the most rapid means of liaison available from Air Service to Air Service, without reference to G-2.

93. All tactical and technical information, whatever its nature, is of direct or indirect interest to all flying, technical, and executive commissioned personnel of the Air Service. Its rapid transmission and thorough dissemination is of prime importance.

CHAPTER VIII.—LIAISON.

94. Effective liaison involves the establishment of mutual understanding, rapid communication, and effective cooperation between the Air Service of the corps, Air Services of the other corps, other branches of the Air Service, and other branches and arms of the service to which the Corps Air Service stands in some tactical or technical relation. Information is gathered by means of liaison.

95. Liaison can not be carried too far. Its scope is limited only by the means possessed.
96. Liaison is carried out by the following means:
Frequent personal visits and conferences.
Permanent Air Service liaison officers stationed at important tactical centers of information.
Mechanical means of long-distance communication.
- Telephone.
- Telegraph.
- Radio.
- Visual signals.
- Motor couriers.
- Airplane couriers.
- Pigeons.
- Mounted couriers.
- Runners.

97. Liaison by personal contact, besides eliciting information, promotes mutual understanding and sympathy between the Air Service and other branches of the service. It is useful in acquainting other services with the possibilities and limitations of military aviation. It forms the basis for the laying of specific plans, prescribing of methods, and establishment of means of rapid communication. Within the corps personal liaison will be frequently effected to include down to Infantry brigades and Artillery batteries.

98. The permanent liaison officer is ordinarily posted with division headquarters and Corps Air Service headquarters of the corps on right and left. The permanent liaison officer at division headquarters is the representative of the divisional squadrons and of the C. A. S. C. He collects and transmits, through the C. A. S. C., to the group and squadron, all tactical information available. He is in close touch with the divisional Artillery brigade commander. He transmits, through the C. A. S. C., all requests for missions. He is the immediate advisor on Air Service matters of the divisional command and staff. He is responsible to the C. A. S. C. for the establishment of a suitable airplane message dropping ground at division headquarters. He interprets, wherever necessary, dropped messages and clears up obscurities.

99. Establishment of adequate mechanical means of long-distance communication is a duty of the C. A. S. C. He must always be furnished with a direct-line telephone circuit from his office to the office of the group commander. The running of telephone lines is a function of the corps signal officer.

100. A special Air Service motorcycle courier connects the office of the C. A. S. C. with the group. Orders, reports, bulletins, and routine administrative papers are transmitted by courier.

101. Carrier pigeons, airplanes, and mounted couriers are used as means of liaison where other means fail. Runners are employed over short distances where road communication by motor despatch is impracticable.

102. The Air Service system of liaison includes the establishment at corps, division, brigade, regimental, and battalion headquarters of suitable dropping grounds for the receipt of airplane written messages. Signal officers are responsible for the establishment and maintenance of dropping grounds. The location of dropping grounds is ordinarily selected by an Air Service officer and, wherever possible, the radio station is established nearby. A detail of enlisted men is on duty at the dropping ground through-out the hours of daylight. The C. A. S. C. prepares map showing locations of all dropping grounds in the corps area for the information of pilots and observers of the group. Distinctive panels, as prescribed in "Liaison for All Arms" (see chapter on information), denote at the same time the locations of headquarters and the emplacements of dropping grounds. Dropping ground panels are displayed by the detail on duty upon the call of the airplane. Calls are sent by signal rockets, short bursts of machine-gun fire, or radio.

103. Liaison includes the taking of any measures which serve to enlist the interest of troops in the work of the Air Service. Divisional squadrons may display special distinctive insignia on the wings and fuselage of airplanes permitting troops to recognize planes of their own division. The morale of troops in action is appreciably raised by the knowledge that "their own plane" is flying over them and assisting operations. Where troops constantly observe in action planes known to be of their own command, a feeling of interest and camaraderie with the Air Service is developed. Cooperation of the troops during infantry contact patrols is a direct result. The dropping of newspapers and cigarettes from airplanes to the troops in advance areas is likewise a means of liaison, promoting, as it does, mutual confidence and sympathy. Visits by pilots and observers to advance positions and the front line during battle is a valuable means of promoting sympathy and understanding between the troops and the Air Service. In like manner visits from officers of combatant troops to the airfield are encouraged. Line officers visiting the airfield gain an intimate first-hand knowledge of the work and viewpoint of the Air Service and disseminate the information obtained upon return to their units.

104. The corps or division commanders may utilize airplanes for communicating to their troops in advance areas. Orders and citations calculated to raise the morale of the forces engaged in battle may be mimeographed and dropped in quantity along the lines.

105. Airplanes communicate with the ground by radio and rocket signaling and by dropped messages. Conventional rocket signals are fixed in plans of liaison of Armies, Corps, and Divisions. Secret radio codes for use by airplanes are similarly prescribed. All airplane radio messages are in code.

106. Ground troops communicate with airplanes by means of signal panels, rockets, bengal flares, and eléctric projectors. Regulations governing the use of ground signals are published in Liaison Plans and the pamphlet, Liaison for All Arms.

CHAPTER IX.—SECURITY.

107. The chapter on security of the airfield, Part I, applies in principle and detail to corps observation stations.

108. During active operations over the lines corps observation planes are largely dependent for security upon the protection afforded by the pursuit effective operating on the sector. Pursuit protection is of two sorts: (a) Extended barrage, and (b) close protection.

109. Pursuit barrage methods are prescribed by the Army Air Service commander. Ordinarily formation of pursuit planes patrol the army and corps sectors at scheduled hours and for stated periods during each day. Certain
CAMOUFLAGE ATTACK

Dive slowly.
Run away apparently scared.

Will lead enemy planes from rear.

Drawn by: Air Service Wash. D.C.
formations are charged with the duty of clearing the air of enemy aircraft and protecting our own aircraft at low and medium altitudes. Other formations fly at higher altitudes and forbid the approaching of our lines by enemy aircraft. To assure the security of observation missions the Corps Air Service commander prescribes the accomplishment of routine missions at those hours of the day when pursuit barrage is scheduled to operate. Close protection of corps observation planes, whose mission carries them deep into enemy territory, is secured by arrangement through the A. A. S. C. between the group commanders of corps and pursuit groups.

110. Where close protection from pursuit units is not available corps observation planes detailed for deep-flying photographic or visual reconnaissance missions assure their own security and are dispatched in formations of varying numerical strength, the number of planes depending upon the reported strength and aggressiveness of enemy pursuit aviation in the sector.

111. Security of corps observation planes flying within the friendly lines is further assured by the protection afforded from enemy pursuit by the antiaircraft defenses of the sector.

112. Lacking other protection the corps observation plane is dependent for security upon its own armament.

113. Security decreases in direct proportion to the increase in altitude and distance from the friendly lines. Enemy pursuit aviation rarely ventures into the friendly lines at an altitude of less than 3,000 feet. Corps planes observing from their own lines at low altitudes are relatively secure both from enemy aircraft and enemy artillery.

114. In conducting observations the intelligent corps observation team seeks the maximum security. Missions are carried out at the lowest altitudes and shortest flight ranges which permit of accurate observation. The enemy lines ordinarily are penetrated by the single plane only for short periods and after careful survey of the air. Repeated short sorties over enemy territory, although they prolong the total duration of the flight, decrease the danger of attack and are therefore preferable to a single extended flight at a distance from the friendly lines. Observation of artillery fire, excepting at extreme ranges during hazy weather, can be accomplished by the experienced observer without crossing the enemy lines. Observation of artillery fire at long range is more easily accomplished from high than low altitudes. For purposes of security it is preferable to fly high within the friendly lines than to fly low in the enemy lines, for the reason that, though the danger of encounter is increased, the plane, if attacked over its own territory, can resort to rapid maneuvers while losing altitude and thus drop into security under cover of friendly ground machine gun and artillery.

115. The use by observers of field glasses is an added measure of security and is encouraged. The use of field glasses permits accurate observation from a safe distance within the friendly lines and the rapid identification of distant airplanes. Long practice is required for the effective use of field glasses. The ability to employ them is an asset rare and valuable among observers.

116. A sky completely overcast by even cloud strata affords added security. Sun glare is eliminated and the area to be surveyed in watching for hostile aircraft is limited. The silhouettes of aircraft within the range of vision stand out sharply against the clouds. Broken cloud groupings decrease security. Scattered banks of clouds afford ambush to hostile pursuit. Broken cloud banks are never approached by the single plane where it is possible to avoid them.

117. Security from surprise attack is dependent upon the constant vigilance of pilot and observer and upon ability of airplane teams to distinguish enemy aircraft from friendly by the silhouette. Pamphlets showing the silhouettes of enemy and friendly types of planes are published by the Air Service Information Section from time to time. These are made available to all flying personnel and are carefully studied and learned.

118. Security from enemy antiaircraft artillery and machine-gun fire is afforded by effecting slight changes in course and altitude at short intervals. Where artillery fire is so dense as to assume the aspect of a barrage a long, steep dive is resorted to, the dive being continued until the lowest bursts observed have passed overhead. The plane then climbs rapidly, changing course at the same time.

CHAPTER X.—ORDERS AND REPORTS.

119. The Corps Air Service operations order is based upon the tactical situation as set forth in information gathered by the C. A. S. C. through liaison channels. The operations order is issued by the C. A. S. C. at the close of each day and prescribes the general and specific lines of activity of the observation group for the following day. It contains:

(a) Friendly tactical situation and plan.
(b) Enemy tactical situation and presumed purposes.
(c) General mission of the corps squadron.
(d) General mission of the divisional squadrons.
(e) Specific missions.
(f) Special information affecting operations.
(g) Any admonitions, advice, encouragement.

120. The operations order is forwarded to the group by M. D. S. Where there is doubt that it will arrive at group headquarters in ample time it is communicated in advance by telephone.

121. In preparing the operations order the C. A. S. C. will advise with the corps chief of staff and the assistant chiefs of staff, G-2 and G-3.

122. Distribution of the operations order:

Group headquarters.
Corps balloon group headquarters.
Army air service commander.
C. A. S. C., corps on right and left.
Corps C. of S.
Corps G-2, G-3.
Commanding general, Corps Artillery.
Commanding generals, divisions of own corps.

123. Operations reports are prepared for the C. A. S. C. by the group operations officer under the supervision of the group commander. They contain a narrative of the salient features of each day's aerial operations. They contain a statistical tabulation of each day's operations, by squadron, showing number and kinds of flights accom-
plished; number of flying hours; number of photographs secured; number of forced landings; number of planes crashed; number of combats; number of casualties; planes and personnel available for the following day's operations. Totals for the entire group follow squadron statistics. For distribution see paragraph 90.

124. A written report of every mission accomplished, except photographic, prearranged artillery adjustments, and courier missions, is furnished by each observer (a) in a dropped message to the P. C. of the division for which the flight is made, and to the corps P. C. in every case, and (b) in a carefully detailed narrative, prepared after landing, under the supervision of the group operations officer. Photographic prearranged artillery adjustments, and courier missions are not reported by dropped messages.

125. The dropped message report is complete but concise. Skeleton phrasing is permitted. All information secured, both positive and negative, dealing with the friendly and enemy situation, is included. The tendency of the inexperienced observer is to omit the dropped message minor details of time and place. All details will be included, no matter how insignificant they may appear to the observer. Locations will be accurately described by coordinates or filled in on an attached map. The message, if dropped at the corps P. C. by a divisional plane, will state in conclusion whether or not a similar message has been dropped at the division, this in order to assure G - 2 of the corps that transmission of the information in the body of the message is or is not necessary. In preparing forms for the writing of dropped messages observers will duplicate, and thus save time, by the use of carbon paper firmly fixed between two or more message blanks, attached by means of rubber bands, thumb tacks, or tape, to a stiff backing. Photographic and artillery missions are not reported by dropped message. Their results are reported by telephone liaison from the group.

126. The full narrative observer's report prepared at the group tells the entire story of the mission, including information of route followed; visibility; and duration of flight; enemy road and railway activity observed; enemy aircraft observed, with description of types or silhouettes and distinctive markings; enemy balloons in ascension, giving location; enemy and friendly artillery activity, locations of enemy batteries in action; density and location of friendly and enemy shell observed; locations and activities of friendly and enemy troops; general aspect of enemy sector, carefully calling attention to any lack of activity where activity might have been expected, fires and explosions in friendly and enemy territory. Where conclusions are drawn they are carefully labeled as such and are not stated as absolute fact. Observers are encouraged to draw conclusions.

127. Inexperienced observers often omit the following essential data in reporting on missions:

- Negative information of enemy sector.
- Exact time of observations.
- Exact locations by coordinates.
- Direction taken by enemy troop and train movements.
- Approximate strength of columns observed on roads.
- Direction of flight of enemy aircraft.

Careful supervision by Corps Air Service and group commanders and their operations officers is the sole means of training observers in the careful and complete preparation of reports.

128. Report of artillery adjustments is made by the observer at the group. The usual flight narrative describing general conditions under which the flight was accomplished is followed by a report of number of rounds fired and number of bursts observed and by an estimate of the result obtained. Failures are carefully reported, stating reasons. Wherever it is possible, special photographs should be taken of the target after an artillery shoot and should be compared with those taken before, so that a definite estimate can be made of the amount of damage done.

129. The photographic reconnaissance report includes the usual narrative, with a statement of number of plates exposed and estimate of area covered. Failures and reasons thereof are reported.

130. Report of encounters and combats with enemy aircraft is made, by pilot and observer in conference, on a special combat report form prescribed by the Army Air Service commander. Report includes a narrative of the incidents of combat; states the approximate number of rounds fired by the pilot and observer; states effect of fire on the enemy and effect of enemy fire. Time, locality, and altitude are carefully noted. Number and type of enemy planes encountered, a description of their characteristic markings, and comments on the tactics employed are embodied in the report.

131. The observer's report is the sum and substance of Air Service information. Its contents are transmitted to all concerned by the most rapid means of liaison available.

132. General principles governing the composition and issuance of orders and reports for the Army promulgated in Field Service Regulations apply to orders and reports of the Air Service.

CHAPTER XI.—MARCHES AND CONVOYS.

133. The principles governing the conduct and regulation of marches and convoys for all Air Service units and groupings are treated of in Chapter V, Part I, of this volume.

134. The Corps Air Service commander and his staff move with corps headquarters.

CHAPTER XII.—PARTICIPATION IN COMBAT—OBSERVATION.

135. During inactive periods in trench or stabilized warfare the Air Service of the corps is charged with the following missions:

(a) To photograph to a depth of 10 kilometers the enemy positions.
(b) To locate by the flash the exact emplacements of enemy batteries.
(c) To adjust the fire of our own artillery on sensitive points and calibrate our guns.
(d) To maintain surveillance of the enemy and assure detection of increased activity indicating preparation for hostile attack.
136. During a friendly offensive the Air Service of the corps is charged with the following missions:

(a), (b), and (c) as in paragraph 135.
(d) To maintain surveillance of the enemy at low altitudes reporting on concentrations of troops for local stands and reactions.
(e) To observe enemy road movement for indications of the bringing up of extensive reinforcements.
(f) To find and report to the command and the artillery the location of the friendly front line by means of low-flying infantry contact patrols.
(g) To control the friendly barrage.
(h) To seek and report on all indications of a general enemy retreat.
(i) To seek fugitive targets, i.e., massed enemy troops, convoys on roads, and to adjust rapid zone fire on such targets.

137. During a general retreat of the enemy and pursuit by friendly forces the Air Service of the corps is charged with the following missions:

(a) To report on the position of the friendly rear guard and the general road aspect of the friendly retreat.
(b) To report to the friendly rear guard and to the command the position of the advance-guard and main body of the pursuing hostile forces.
(c) To effect liaison between the command and the right and left flanks.

138. During an enemy offensive met by stubborn resistance the Air Service of the corps is charged with the following missions:

(a), (b), and (c) as in paragraph 135.
(d) To maintain constant low-flying surveillance of the enemy and report in advance his preparation for each successive effort to break through the friendly lines.
(e) To observe enemy road movement for indications of the bringing up of extensive reinforcements.
(f) To locate enemy cantonments, camps, dumps, axial roads, and other suitable targets for the destructive and harassing fire of the friendly artillery.
(g) To find and report to the command and Artillery the location of the friendly front line during and after each enemy effort to break through.
(h) To control the friendly barrage.
(i) To adjust rapid zone fire on fugitive targets and concentrations of enemy troops preparing for assault on the friendly positions.

During a general friendly retreat and pursuit by hostile forces the Air Service of the corps is charged with the following missions:

(a) To report on the position of the friendly rear guard and the general road aspect of the friendly retreat.
(b) To report to the friendly rear guard and to the command the position of the advance-guard and main body of the pursuing hostile forces.
(c) To effect liaison between the command and the right and left flanks.

139. Under all conditions the Corps Air Service holds one, two, or three airplanes at the disposal of the corps commander for the accomplishment of special missions demanded by developments in the tactical situation.

140. Photographic missions are requested as need arises. All requests for photographs are transmitted to the Air Service by G-2 of the corps, to whom the completed prints are delivered for distribution. During stable trench warfare tactical maps are based on data furnished by corps and army aerial photographs of the enemy's territory. Photographs during war of movement are of little value in studying the enemy organization but serve to acquaint the command with details of terrain. Oblique photographs of the enemy's front-line defenses in either stable or open warfare are extremely useful. They are distributed down to include commanders of infantry platoons and serve to acquaint the command and troops with the nature of the terrain and defenses immediately confronting them. During stable trench warfare, photographic missions are a matter of daily routine, to be accomplished by the Corps Air Service upon every day of favorable weather. During open warfare photographic missions are only occasional and are requested to clear up map obscurities or meet other specific demands for information. The preparation of the photographic mission involves communication to pilot and observer, by C. A. S. C., of the limits of territory to be covered. The work is carried out by formations. The usual altitude from which corps photographs are secured is 3,000 meters. It is sometimes impracticable to send formations of planes on photographic missions. In this case the mission is carried out by a single plane, flying at great altitude, 5,000 to 5,500 meters. The security of the plane is increased by its inconspicuousness at extreme altitudes and the rapidity with which it can cover an extended area from great heights. In the case of certain types of planes (examples of which are the French Salomon and Breguet) which retain their qualities of speed, climb, and maneuverability at extreme altitudes, security is further afforded by the ability of the single plane, relying on its qualities of speed and climb, to outdistance attacking enemy pursuit. During periods of unsettled weather photographic missions are ready to take the air from early morning. Instant advantage is taken of any break in the clouds. Under these conditions pursuit protection will not be counted upon, owing to the loss of time involved in meeting the protection at the rendezvous. During midsummer, sunlight is usually best for the securing of photo-
graphs between 8 and 16 o'clock. Photographic missions during the spring and autumn months are ordinarily between 10 and 14 o'clock. In winter good photographs are secured usually only between 11.30 and 12.30 o'clock. During a continued siege of bad weather or during an offensive, efforts must be made to secure photographs, if opportunities permit, at hours other than those named above.

141. Location of enemy batteries in action by the flash is a routine mission of corps observation units during all situations excepting that of general friendly retreat. Battery flashes are best observed just after daybreak and just before nightfall. They are rarely picked up, even by the vigilant observer, in broad daylight. Where it is known or suspected that a concentration of enemy batteries has been effected within certain specific limits bounding a very restricted area a single reconnaissance plane charged with the sole mission of locating exactly the flashes of batteries in that area will ordinarily meet with success. Surveillance planes searching the sector for miscellaneous information are only moderately effective in locating batteries. The plane seeking to locate batteries in action should fly at the lowest altitude permitting observation and should remain as far behind the friendly lines as the work will permit. Once the plane’s presence is detected by the enemy, batteries will ordinarily cease fire. Information of enemy batteries in action is communicated to the divisional and corps commands immediately by radio and later confirmed by dropped messages. Enemy batteries in action may be effectively counterbattled by the assistance of the airplane reporting them. For this purpose the artillery assigns suitable counterbatteries. Liaison with these batteries is then effected. When arrangements are completed between the batteries and the Air Service the counterbatteries are prepared to receive radio calls from all planes and the corps during the hours of daylight and to adjust fire on targets reported without delay. It is a function of the C. A. S. C. to assure wherever possible the assignment of such counterbatteries and to provide for adequate liaison in order that the minimum of failures may result. Counterbatteries thus arranged for become, during active periods, fugitive-target batteries. Theoretically, all batteries are ready to receive airplane calls and adjust at all times. Practically better results are obtained by assigning only a few batteries for this type of work and carefully perfecting liaison arrangements. All corps and divisional observers are supplied with the necessary information for calling counterbattled and conducting adjustments, in accordance with the arrangements effected.

142. Detailed instructions for adjustment of artillery fire by means of airplane observation are contained in Confidential Pamphlet No. 80 (revised) G. H. Q. A. E. F., May, 1918, “Aerial Observation for Artillery.” Successful adjustment of artillery is largely dependent upon carefully accomplished liaison. The best work is achieved after a visit by the observer to the battery with which he is to conduct fire. The adjustment should be arranged by conference between the observer and the battery commander, details of method, time, and panel and radio signaling being thoroughly discussed and a complete understanding and agreement reached. Before leaving on the mission the observer notifies the battery by telephone or radio that he is about to start. In preparing the mission the observer equips himself with a large-scale map bearing coordinates in secret letters and showing the location of the target. If an aerial photograph of the target is available, this will be attached to the map, properly oriented and squared off to scale. The photograph renders exact location of bursts observed extremely easy. Batteries which do not respond to the radio call of the plane may be called by dropped message. In like manner batteries whose calls are not known to the observer may be notified that an adjustment is required, and all necessary data for opening fire and establishing radio liaison may be included in the written message. The battery replies by panel signals whether or not the work requested can be undertaken and what method of fire will be used (see “Aerial Observation for Artillery”). Liaison between the airplanes and artillery is at all times complex and difficult of perfection. The conditions governing its effective establishment change with the tactical situation and can not be laid down by any rule which will cover all cases. Corps Air Service commanders will be called upon to use great energy and ingenuity in assuring effective cooperation between the Air Service and the Artillery. This will be particularly true during active periods in war of movement.

143. Surveillance of the enemy is a routine mission of corps and divisional squadrons during all tactical situations. The corps squadron patrols the entire corps front, reporting on the general activity of the entire sector to a depth varying from 5 to 10 kilometers. The divisional squadron patrols within the boundaries of the divisional sector, reporting in detail on all activity observed. Effective sector surveillance implies an accurate knowledge of the terrain by the observer. The observer should be familiar with the latest information on the tactical situation in order to concentrate his attention on those points which are of most interest to the command. Sector reconnaissances are increased in frequency as combat activity or preparation for activity increases. During actual offensive or defensive operations they may overlap, establishing an unbroken watch on the movements of the enemy. Surveillance planes are fitted with radio equipment and are prepared to call the artillery into action whenever need arises.

144. Control of the friendly barrage may be advantageously conducted by airplane. Where the barrage extends across the entire corps front and is participated in by both corps and divisional artillery the corps artillery is observed by a plane from the corps squadron; the divisional artillery is observed by planes from the divisional squadrons. Observers controlling barrages are provided in advance with maps showing the barrage schedule, minute by minute. Control consists in reporting by radio to the corps and divisional artillery brigade headquarters any failure of the barrage to play accurately and on schedule time, giving approximate location, density, and caliber of bursts observed to be inaccurately placed or off schedule. Close adjustment of the barrage is not undertaken.

145. The general principles and specific regulations governing the conduct of infantry contact patrols for the
The contact patrol is a mission of the divisional squadron. The contact patrol is most effectively carried out at an altitude ranging between 100 and 600 meters, depending on the visibility. Troops frequently disregard the call of the plane to display panels. From these altitudes troops can be plainly distinguished and identified by the color of the uniform. Where troops do not show panels, observers will not report the location of the “front line.” They will report the location of the “most advanced friendly elements observed.” The infantry panel is the only guarantee of the exact location of the divisional squadron. The contact patrol is most frequently located by the color of the uniform. Vehicular troops, and 600 meters, depending on the visibility. Troops effectively carried out at an altitude ranging between 100 and 600 meters, depending on the visibility. Troops are seen but no panels are displayed upon the call of the plane there is reason to suppose that the actual front line is still further advanced. Even though the observer can locate no friendly troops beyond a certain point, he will not report the location of the “front line” until panels are shown. The infantry contact plane will never proceed directly from the air-drome to the point which the advance of the friendly troops is presumed, by schedule, to have reached. It will proceed to that point where the most advanced elements were last definitely reported. Having reached this point, the plane will assure itself, by observation of movement of troops on the ground, that the advance has continued. It will then gradually extend its observation farther and farther to the front, working back and forth across the sector, until the observer can distinguish no friendly troops beyond. The line is tallied at this point. If no panels are shown the plane will carry observations somewhat deeper, but with extreme caution. When satisfied that the limit of the friendly advance has been reached and noted, the observer will immediately report to division and corps headquarters by dropped message. During such flights the airmen must bear in mind that the infantry can best observe their signals when their plane is in front and at an angle of about 45 degrees to the infantry lying prone on the ground. The contact patrol observer will bear always in mind the possibility of enemy counter attacks and will constantly watch for enemy troop concentrations. Where counter attack appears imminent the observer will drop a message to that effect to the front-line elements most nearly concerned. He will then call the fugitive target battery and adjust neutralizing zone fire over the terrain where concentration had been observed. Contact patrols frequently locate enemy machine-gun nests. Where hostile machine guns are observed the front-line troops are notified of the danger by dropped message. Contact patrol planes may assist the advance of friendly troops by opening fire on enemy machine guns, silencing them until they can be captured.

146. In directing the operations of the Air Service the C. A. S. C. maintains liaison with the corps and divisional balloons. He is assisted in this function by the Corps Balloon Group commander. The C. A. S. C. do not duplicate the work accomplished, or in course, by the balloons. He will establish as a principle that work which balloons can accomplish will not be undertaken by airplanes. This will usually apply to the accomplishment of artillery missions. Certain areas in enemy territory are obscured to balloon observers by inequalities in the terrain. The areas not deflated by the balloons decrease in number and extent with the increase in altitude. Those areas closed to balloon observations at varying altitudes will be sketched in on a map for the use of the Corps Air Service and group commanders in determining what missions properly fall within the province of the balloons during varying conditions of visibility. A copy of the balloon deflation map is posted for the information of flying personnel in the group operations room.

CHAPTER XIII.—SHELTER.

147. The principles governing shelter of troops in the field, established in Army Field Service Regulations, apply to the troops of the Corps Air Service.

INTRODUCTION.

Army Observation.

148. The Army observation units function as an organ of the high command. They are placed at the disposal of the General Staff of the Army and their activities conform to the orders issued by the General Staff. The chief function of the Army observation units is to keep under constant surveillance the dispositions and movements of the enemy’s forces. This requires reconnaissance, both visual and photographic, in depth, of the entire Army sector. Their prime object being the gathering of information, it is necessary that they operate in spite of enemy aerial opposition. However, engagement of the enemy’s air forces in combat must be avoided so far as possible, except when the nature of the mission demands it and when the chances of gain are commensurate with the risk involved. Airplanes must not be risked unnecessarily over the lines to obtain information which is more easily procured by terrestrial or balloon observation.

CHAPTER XIV.—INFORMATION.

149. Information as to the enemy and as to our ground forces is essential to the proper tactical operation of any observation unit, whether it be an independent squadron, a group, or a larger organization.

150. The collection, preparation, and circulation to the smaller units of the command of this information is the duty of the Army Air Service commander. Every commander of a large unit, wing, or group will see that all essential information which he receives is circulated to the component elements of his command. It is the duty of all commanders at all times to act on the principle that the collection of information without its circulation is useless. Information properly circulated to observation units has an important moral effect upon the flying personnel. It is to be remembered that except when actually in the air aviators are removed from the sights and sounds of the battlefield, and only by a thorough information system can
the various possibilities of the military situation be brought home to them. Unless these possibilities are made clear it is impossible to obtain the maximum efforts from the personnel.

151. The operations officers of the various units (separate squadron, group, or wing) are responsible for the supply of their respective units with:

(a) Maps of 1/20,000 scale, covering the entire sector. These maps should be colored so that the prominent topographical features are easily referred to.

(b) Maps of 1/60,000 scale, covering the entire sector, for use by observers. It is of paramount importance that these maps be colored, so as to make reference easier.

(c) Maps of 1/200,000 scale, covering the entire sector, for use by pilots and observers.

(d) Maps* of 1/20,000 scale, covering the entire sector, showing by means of conventional symbols, all the important artillery objectives. These maps are printed at frequent periodic intervals by the second section of the General Staff (G-2).

(e) Maps* showing the organization and occupation of the sector by ground troops. These maps show the location of the different friendly divisions in line.

(f) Daily enemy order of battle map, showing the location, both known and probable, of all enemy divisions, both in line and reserve.

(g) A map* showing the location of all known enemy airfields. This map should indicate, by conventional symbols, whether the airfield is occupied or unoccupied.

(h) A map* showing the location of all enemy balloons.

(i) A map* showing the precise location of all the known enemy antiaircraft batteries and their caliber.

(j) A map showing the enemy areas that are deflated from the different friendly balloons. This is valuable in that the airplane observers can pay particular attention to areas protected from observation by balloons.

(k) A map* showing the enemy’s system of railroads and the railheads.

(l) A map* showing the main roads over which traffic is heaviest. These are indispensable to observers, that they may know beforehand where to look for traffic.

(m) A map showing the location of all friendly airfields in the sector of the Army Air Service commander. The pilots and observers should be familiar with the location of all these airfields, so that in case of a forced landing, if they should become lost, the breaking of a plane may be avoided.

(n) Silhouettes,* photographs,* and tables* of performance of all known types of enemy airplanes will be prepared or secured. These are essentials, and must be studied carefully by the flying personnel.

(o) Charts showing the lighting system of enemy airfields and signals for planes at night.

(p) All photographs available of the enemy airfields, dumps, towns, etc. It is well to arrange these in alphabetical order in books, so that easy reference can be made to them, and so that when new photographs are taken they can be compared. Also, it is necessary that these be at all times kept at the disposal of the pilots and observers for study, to aid the flyer to recognize them when flying over enemy territory. Stereoscopic views of all these points should be prepared and placed at the disposal of the pilots and observers for study.

152. Charts, diagrams, and maps should be supplemented by:

(a) Army summaries of intelligence, prepared by the second section of the General Staff (G-2). It is of paramount importance that these be supplied to the squadrons and that they be at the disposal of the pilots and observers, as it is difficult to prevent these officers from suffering a feeling of discrimination in favoring the other arms of the service unless these summaries are furnished to them.

(b) Air Service summaries of intelligence will be prepared in the headquarters of the Army Air Service commander, to supplement the Army summaries of intelligence. These should cover all subjects relating to the enemy Air Service and especially should deal with the types of planes and ways of using them, as learned from all available different sources, such as reports from agents, statements of prisoners, and captured orders and documents of all sorts.

(c) The Army Air Service operations orders and reports, prepared in the headquarters of the Army Air Service commander, showing the activities of all Air Service units under his command.

(d) All available documents and pamphlets concerning the enemy’s forces, paying particular attention to information concerning the enemy’s aerial forces.

Note.—Items marked * are prepared and distributed at frequent periodic intervals.

It is one of the duties of the operations officer of every observation unit to attend to the details of the circulation of information within the command. It is imperative that the observations and experiences over the lines of every pilot and observer be made accessible to every other pilot and observer in the organization, in the most inviting manner, without delay.

CHAPTER XV.—LIAISON.

153. Owing to the absolute necessity for cooperation between the various Air Service units under the command of the Army Air Service commander, and also with the various arms of the service, great importance must be at-
tached to the preparation of means of communication for receiving and transmitting information and orders. A rapid and complete comprehension of the entire situation has decided influence upon the success of operations. For mutual comprehension of plans, possibilities, and limitations, nothing can be substituted for personnel contact.

154. The exchange of personal visits between pilots and observers and officers of other arms stationed nearer to the front will be encouraged as much as possible. All Air Service commanders in the field will exchange personal visits with officers of corresponding rank and will see that their subordinates of all ranks come into close personal contact with officers of corresponding rank in the divisions in the line and in reserve, in the antiaircraft artillery, both machine gunners and heavier gunners, in field and heavy artillery, with balloon observers, and with all other Air Service units, including bombardment and pursuit as well as observation.

155. In order that a maximum return may be secured from the observation units, it is necessary that the best possible means of communication be established, as follows:

(a) By direct telephonic installations to the headquarters of the Army Air Service commander, Army G-2, and G-3.
(b) By telephonic liaison with all the Air Service units under the command of the Army Air Service commander.
(c) By liaison by radio with the station established at headquarters, Army Air Service commander.
(d) By dropping messages from airplanes on the dropping ground established near the headquarters Army Air Service commander.

156. Liaison by aircraft is still to be developed as a means of reporting promptly the information obtained concerning the progress of the battle, but with the development of wireless telephones for communication between planes and between planes and the ground, the utilization of aircraft as a means of communication will be more and more emphasized.

157. Every observation group will be equipped with a sufficient supply of telephones and wire to insure the establishment of its internal liaisons—the group operations office and headquarters being directly connected with the several squadron headquarters and operations offices. The establishment of telephonic liaison from the wing headquarters to the group headquarters and from the group headquarters to the group headquarters and from the headquarters of the Army Air Service commander to the wings and separate groups of his command is the duty of the Army Air Service commander. He will arrange with the chief signal officer of the army in the field for the installation of these telephone lines before ordering these units to their new stations.

158. In order to insure close cooperation between pursuit and observation planes while in the air it is necessary for the group operations officer of the Observation Group to inform the operations officer of the Pursuit Group as to the time of departure of the missions, the number of planes in the formation, the altitude at which they are going to work, the probable time of crossing and recrossing the lines, and the route to be covered, in order that the pursuit patrols operating over the same area at the time may be notified and may pay particular attention to the safety of these formations.

159. The operations officer of each of the various units is responsible for the interrogation of all pilots and observers immediately upon their return from missions and for securing a full, accurate, and intelligible report of all observations of interest to the General Staff. This report should be transmitted by him by telephone, if possible, direct to the headquarters of the Army Air Service commander.

CHAPTER XVI.—COMBAT.

160. General Principles.—The object of tactics, as employed by Army observation planes, is to avoid combat with enemy planes, to allow the observers to obtain the desired information and return to the airbase with it. The Army observation planes do not accept combat otherwise than as a defensive measure. Definite tactics to be employed by formations of observation planes have not been adopted. Methods depend entirely upon the ability and initiative of the flight commander, the pilots comprising the flight, and the conditions. Owing to the fact that the Army observation units operate far beyond the line of friendly pursuit patrols it is necessary that they depend largely upon their own means of defense. However, even though formations of observation planes are employed, the cooperation between pursuit patrols and observation formations, when the latter are operating within range of the pursuit patrols, should be as close as possible. The numerical strength of a formation depends entirely upon the depth to which it must penetrate the enemy's territory and the known aggressiveness and numerical strength of the enemy's air forces. Missions must never be attempted by individual airplanes except when the weather conditions are such that formation flying is rendered impossible.

161. Formations.—During the hours of daylight, the weather conditions permitting, the missions assigned to the Army observation squadrons will invariably be carried out by formations. These formations should not be too large. A formation of four planes, flying in diamond formation, has been found very effective, as it is easily controlled by the leader and is very flexible. All formations must have the following characteristics:

(a) Simplicity.
(b) Maneuverability.
(c) No dead angles.
(d) Concentration of fire to the rear.
(e) Compactness.
(f) Each pilot must be able to see the leader.

162. Airplanes in formation are numbered as follows:

1 3 2

No. 1 is the leader and flies at the lowest altitude, Nos. 2 and 3 fly at the same altitude, about 25 meters higher, 25 meters to the rear, and 25 meters to the right
and left of No. 1, respectively, while No. 4 closes the diamond, as it were, flying about 25 meters above Nos. 2 and 3 and about 25 meters behind, keeping directly behind No. 1.

163. In the event that the formation is attacked the formation must be kept as compact as possible. The maximum security will be maintained by keeping the closest possible formation—15 to 20 meters between airplanes. In this manner the blind angles of one airplane are covered by the other airplanes of the formation, thereby preventing the enemy airplanes from closing in to short ranges without exposure to concentrations of fire from the different airplanes. The usual tactics employed by the enemy pursuit airplanes against formations of bi-place airplanes is to remain at long ranges, firing short bursts to confuse the pilots and observers so that they will break up the formation. It is fatal for any airplane to become detached from its formation, as it will then be subjected to the concentrated efforts of the enemy pursuit pilots and will be easy prey for them.

164. In order that there may be mutual understanding between the pilots and observers of the flight it is necessary that they should know the following:

(a) The various signals for communication between airplanes.

INTRODUCTION.

167. Pursuit aviation has for its object the destruction of the enemy air service and the protection of our own observation aviation. When opportunity offers it will take part in the battle on the ground, inflicting maximum casualties and weakening the morale of the enemy’s ground troops. Whatever later developments may appear, up to the present time the basis of the Air Service has proved to be that portion devoted to observation. But observation, aviation’s very existence, depends upon a powerful, well-trained, and aggressive pursuit aviation. So that our own observation airplanes and balloons may be protected and may feel and see that they are protected, while the enemy’s aviation is destroyed and driven back from the line of battle, pursuit aviation is employed.

CHAPTER I.—INFORMATION.

168. Information as to the enemy’s and our ground forces is essential to the proper tactical operation of any pursuit unit, whether it be a separate flight, an independent squadron, a group, or a larger organization.

169. Every wing, group, and squadron headquarters, including the headquarters of the squadrons which comprise the groups and wings under his command, will be supplied by the Army Air Service commander with:

(a) A map giving the location of all enemy airclromes. This map should indicate by symbols whether or not the airclromes are occupied and should bear upon its face an easily read key, so that the quantity and kind of enemy air service can be taken in at a glance.

(b) A map showing the precise location of all enemy antiaircraft artillery units, showing their kind. This map and all others should be issued at frequent periodic intervals and never allowed to get out of date.

(c) The mission to be accomplished.

(d) The altitude at which they will fly.

(e) Their relative positions in the formations.

165. The flight commander, being responsible for the tactical employment of the formation while in the air, must take all the necessary precautions to prevent the formation from being surprised by enemy airplanes. He will pay particular attention to the sun and to the clouds that are above the level of the formation, behind which enemy airplanes may be lurking.

166. Single airplanes.—Missions are carried out by single airplanes only when atmospheric conditions, such as low-hanging clouds and mist, prevent the employment of formations, and early reconnaissance, when darkness forbids the employment of formations. When single airplanes are operating under or above the clouds it is an easy matter for the airplane to enter the clouds, which afford excellent protection in the event of being attacked by enemy airplanes. However, to operate at such low altitudes, far beyond the enemy lines, under and in the clouds, requires the employment of pilots and observers of exceptional ability. They must know: (a) The terrain thoroughly; (b) the direction and speed of the wind at different altitudes; and (c) how to navigate in the clouds by compass.
using them, as learned from prisoners, captured orders, and documents of all sorts.

It is one of the duties of the operations officer of every pursuit unit under the commanding officer to attend to the details of the circulation of information within the command. It is imperative that the observations and experiences over the lines of every patrol leader and every pilot be made accessible without delay to every other pilot in the organization.

CHAPTER II.—LIAISON.

171. In order that a maximum return may be secured from our pursuit aviation, and in order that the enemy may not throw an overwhelming force of pursuit airplanes on the line at certain hours of the day, it is all-important that close liaison be maintained with the front at all times. This liaison should be perfected so that every group commander can be informed without delay of the number, type, altitude, and direction of flight of all enemy airplanes and formations approaching our front lines in the sector for which his group is responsible. This liaison may be established:

(a) By direct telephonic installations to forward observing posts established at intervals on or near the front lines, in charge of Air Service officers.

(b) By telephonic liaison with the antiaircraft artillery observation posts. Messages relative to enemy aircraft activity from the antiaircraft artillery to a pursuit group should have priority over the Army telephone lines, because Air Service units practically alone can be utilized to influence an action in progress.

(c) By liaison by wire with the radiogonio-metric stations.

(d) By liaison by radio either with forward observing posts established by the Air Service or with radio-equipped forward observing posts of the antiaircraft artillery.

172. Liaison by aircraft is still to be developed as a means of reporting promptly upon the progress of fighting in the air. With the prospective development of wireless telephone for communication between formations and between airplanes and the ground, the utilization of aircraft as a means of communication will be more and more emphasized.

173. In addition to immediate reports upon the number, type, altitude, and direction of flight of enemy airplanes, daily reports should be made to the group commander upon the size, altitude, and methods of operation of all elements of the enemy air service. These reports must be prepared by Air Service officers detailed by their group commanders to keep watch from the ground upon the enemy air service from advance observation posts.

174. Every pursuit group will be equipped with a sufficient supply of telephones and wire to insure the establishment of its internal liaisons—the group operations office and the several squadron operations offices being directly connected. The establishment of telephonic liaison from the wing headquarters to the group and from the headquarters of the Army Air Service commander to the wing and independent groups of his command is the duty of the Army Air Service commander. He will arrange with the chief signal officer of the army in the field for the installation of these telephone lines before ordering these several headquarters to new stations.

175. In order that our pursuit aviation may make safe the work of our observation aviation, close liaison must be maintained with all elements of the observation air service, and the pursuit group commander should have at all times as complete a knowledge as possible of the number, altitude, and route of all observation airplanes working in the sector for which his group is responsible. This liaison will be helpful also in keeping track of the movement of our advanced infantry and cavalry elements, and in the selection of targets for ground strafing.

176. While the prime duty of pursuit aviation is fighting in the air, pursuit pilots will occasionally be called upon for special reconnaissance, and will make valuable observations from time to time in the course of their patrols. This will not be allowed to interfere with their combatant operations.

177. The squadron operations officers are responsible for the interrogation of all pilots upon their return from flights and for securing a full, accurate, and intelligible report of all observations of interest to the higher command. This report should be submitted immediately, by telephone if possible, through channels, to the Army Air Service commander, who will transmit it to the second section, General Staff (G-2).

CHAPTER III.—COMBAT.

I.—GENERAL PRINCIPLES.

178. The guiding principle in pursuit tactics is to seek out and destroy enemy airplanes. Contact is made with the enemy by chains of formations, formations, and by individual machines. Before passing on to study the tactics used by each, it is to be remembered that the primary object of the aerial force working with an Army is to keep the enemy under observation. It performs in part, what was once the chief function of the cavalry, and preventing the enemy from observing our dispositions and maneuvers, seeks to keep him under continual surveillance. The eyes of the Air Service are observation airplanes and balloons, but the arms and weapons are the pursuit airplanes. Without the latter, two-seaters would be blinded by the enemy air forces to such an extent that their missions would fail and they would have to resort to fighting tactics. The pursuit airplane is also the best weapon with which to blind the enemy in the air, by continually destroying and harassing the hostile two-seaters.

179. The pursuit elements of the Air Service have as their prime function to keep clear of enemy machines an area equal in depth to the distance over the enemy lines which is allotted to the corps and divisional observation squadrons. In other words, the aerial front line must be maintained, at minimum, as much in advance of the line of battle on the ground as the range of the Corps Artillery. Pursuit machines, therefore, specialize on fighting, and of necessity have to adopt certain tactics, varying with the type of machine used, with the activity of the sector, and with the altitude at which they are working. But certain principles are universally applicable.
The point of view of esprit, of using the flights of a squadron at present five or six, is the tactical unit of pursuit aviation. When more than one flight is to be used for any given purpose, emphasis is to be laid upon the value, from the point of view of esprit, of using the flights of a squadron echeloned together in a chain of formations.

II. TACTICS OF SINGLE MACHINE.

(a) The unit of the formation.

181. A great deal of attention has been given to the tactics of the single machine, and it might be argued that this amounts to nothing more than tactics of the individual pilot. This is indeed a fact, except that a great deal depends on the make of the machine in use, but there are many principles in individual aerial combat tactics that apply to all pursuit planes, and that must be followed closely.

182. The individual pilot in a formation must be a disciplined subordinate officer, with confidence in his leaders. A single machine must be part of the team. The team must be the unit to engage the enemy. It must be remembered that the pursuit machine has no defense after a surprise other than its maneuver ability, and for this reason, only pilots of the longest experience and the greatest ability should be permitted to engage in individual patrols, and then only on rare occasions. Up to the point where the pursuit machine is attacked its defense consists of the eyes of the pilot, plus its speed. It is quite possible for a single machine to get out of very awkward predicaments provided they are seen by the pilot in time and proper tactics are employed. When once attacked, the pursuit pilot depends for success upon his ability to shoot and maneuver. The only safe protection from the attack the single seater has, besides the eyes of the pilot, is altitude, but the higher the pursuit machine gets, the less likely its pilot is to see any enemy machines below him, and the fewer machines will be encountered. The object of the attack of a formation is to break up the enemy group and resort to single combat without losing the chain of responsibility, so that throughout the combat the mental unity of the flight is not lost. When this stage is reached, the individual pilot must close in and at close range deliver accurate and effective fire. Under no circumstances must he be drawn away from the rest of his flight, no matter what the results of his fire may have been. He must carefully avoid being drifted over by the wind farther into enemy territory, or pulled away by any ruse whatever. If he is separated from his formation, he must fight constantly, relying on being able to fly back home at low altitude, if necessary, remembering that it is fatal to dive straight away. Even in case of engine failure the aggressive spirit must be maintained until the ground is reached.

(b) When single machines are permissible.

183. At times opportunity presents itself for individual pilots to perform a mission. On days when the weather is very bad, for instance, it sometimes becomes necessary for individual machines to cross the lines at extremely low altitude and penetrate to certain objectives for the purpose of gaining information of great value. At other times the enemy will seize the opportunity afforded by very bad weather and use specially designed armored machines for strafing the infantry at a very low altitude. On misty days it is sometimes impossible to attack these enemy airplanes, except individual machines, flying as before, at an extremely low altitude, and in this case all the elements of success called into service by a formation leader must be employed. Surprise being the greatest asset, the pilot should, if possible, close in on the enemy machine by flying through the clouds a portion of the time, making allowance for the speed of the enemy machine and for other possibilities, so that the surprise will be complete and the personnel be destroyed by a heavy cone of well-directed fire at close range. Another occasion when it is permissible for a single machine to be sent on a mission is when a single enemy airplane penetrates far behind our lines and must be destroyed at any cost. At such a time it is well to attack the enemy with individual machines, rather than wait to dispatch a formation and run the risk that the enemy machine will reach home safely with the information gained.

(c) Single seater v. single seater.

184. When a single seater attacks a single seater, his ideal objective is to get directly behind his opponent's tail, at a very close range, where tanks, engine, and pilot are in line, and where no care has to be taken as to deflection in aim. If the element of surprise has not been effected, the only manner of getting this advantageous position is by making the enemy dive away. A good pilot, however, will never dive away, and the fight resolves itself into a battle to gain the higher position. A pilot must never allow his machine to lose altitude or fall into a spin. This calls for perfect flying, such that just the right moment of rudder is used at the proper time, and such that the flight can be moved at will toward supports or away from enemy reinforcements, as the case may be. Above all, a pilot's attack must be vigorous, and if he should be so unfortunate as to be outnumbered greatly, he must maneuver coolly, but in a very erratic course, until he can damage or destroy one of the enemy machines, without himself being trapped. He must do his best to keep all enemy machines in sight and never permit an enemy pilot to align the axis of his machine in his direction. It is quite possible for one good single seater to engage as many as three, four, or even more enemy pursuit machines for 20 minutes and get back safely to his lines. To a certain extent the type of airplane will govern the particular maneuvers employed.

(d) Single seater v. two seater.

185. Attack by a single seater on a two seater machine is, of course, very much more difficult. It should be made in cooperation with another machine, but when this is not possible the pilot should aim at closing in to short range, delivering his first burst before the observer is able to reply. When two or more machines attack a single seater, it is necessarily by zigzag courses, relying on the extra speed to close in despite the observer's fire, and at close range deliver hot bursts. When close in under the enemy's tail, make it a practice to turn opposite to the
ATTACK on TWO SEATER
by FORMATION of
PURSUIT PLANES.
way he does. In this way it is practically impossible for the enemy observer to train his gun on you.

(c) Decoy work by the single seater.

186. There is another case when individual flying can be resorted to, and this is in decoy tactics. Usually a machine goes out alone, but in the sight of a larger formation. Sometimes it meets at a predetermined point, at a given altitude and time, and there the formation conforms to the movements of the decoy. The best advice for a decoy machine under those circumstances is to follow an erratic course. It should never fly straight at all. The pilot should be securing the sky systematically and thoroughly at all times, and should use his head to obtain the greatest results by decoying the enemy down on him or attracting the enemy's attention from the higher friendly formation above. It is essential, in decoy tactics, that the utmost cooperation and confidence exist between the leader of the patrol and the decoy, so that there will be no chance of their getting out of touch.

III.—The Single Formation.

(a) General.

187. Good formation flying is the greatest essential in pursuit work. The greatest results can not be obtained by units that do not do good formation flying. A unit with this asset is certain of success and will attain the greatest point of efficiency. The first essential is to get a good leader; the second is to maintain the relative positions of the machines; the third in liaison and cooperation between the machines of the formation, and last, but not least, is the chain of responsibility in the flight.

188. The normal formation should comprise a double echelon, in depth and in altitude, the planes at the rear being highest up, so that they can take advantage of their altitude to close in on the patrol leader by diving, in case of necessity. The normal formation is that of an inverted "V," the patrol leader at the head, number two and number four on his left rear, number three and number five on his right rear. Number two and number three should be 100 and 200 yards apart and about 50 yards above and behind number one. Number four and number five should be between two and four hundred yards apart. The shape of the inverted "V" whether the angle is to be acute or obtuse, will depend upon the visibility from the particular type of airplane in use. When several flights are used as a chain the same principle is employed. The guide for the chain of formation flies at the head of the leading flight, one flight behind, above, and to his left, the other behind, above, and to his right. Where chains of more than three flights are employed each echelon of three flights will use a similar formation and while guiding on the leader will also maintain its own formation.

(b) The leader and his responsibilities.

189. A successful patrol leader must possess the complete confidence of his flight and all that this entails. While the leader is under definite orders always, a great deal depends on his ability to engage the enemy at the most opportune moment, retaining his disposition of machines and launching his attack or maneuvering his formation as occasion demands. He will be well advised to allocate certain positions to pilots and then maintain them on successive patrols, in so far as possible. Communication between machines must be simple but certain, and he can obtain this by signals with his wings or by firing Very lights. The prospective development of the wireless telephone will be of great assistance in increasing the efficiency of patrol leading. Each machine in itself must be in a position to signal to the leader. In short, there must be a chain of responsibility, running from the leader through the deputy leader to each successive machine of the formation, to the last man, so that position and liaison may be maintained under a competent leader, no matter what circumstances arise or what disaster befals the unit. After much practice that state of proficiency will be reached where a formation can be worn down to two machines but still maintain its unity as a formation, with its leader and the second machine working in cooperation ready for combined effort.

(c) Fighting tactics.

190. The actual fighting methods of the formation are much the same as for the chain of formations, with the exception that the leader, in attacking and meeting the attacking line of machines, usually breaks off his individual attacks and climbs to support the rear machines or to hold himself in readiness to get his formation together in a hurry. It is essential to demand this of the leader in spite of the temptation he will have to close in on his adversary. He will often be under the necessity of sacrificing a personal victory to the better judgment indicated. In an attack by a formation every effort should be made to obtain unity to the last. For this purpose it is well to attack the highest and rearmost enemy machines, if attacking from above, or if from below, the straggler should be selected for concentration. Each man of the formation should be able to surmise the intentions of the leader, and in this way concentrated effort is more apt to be attained. In order that a perfect understanding may prevail among the pilots of every flight, they will live together on the ground and will be encouraged to talk over at all times the situations which have been or are likely to be encountered in the air. If it is impossible to close in on a formation owing to its superior speed or altitude, the next best alternative is to wait until the formation endeavors to make a turn and then launch the attack with great vigor. The enemy can be broken up much more easily at this point than if he is flying straight away and has advantage of the height and speed. Great care in the attack must be exercised by all leaders to see that the formation itself does not straggle, because on going down on the attack, altitude is lost so quickly by the front line that supports often get out of touch, with disastrous results, amounting, as it does, to a split in the attacking formation. It is found in practice that it is easier to keep a formation of pursuit machines intact in a combat than large two-seater machines, provided the pilots are sufficiently well trained. This is due, undoubtedly, to their superior maneuverability.
METHOD of ASSEMBLING CHAIN of FORMATIONS
191. Formation flying depends so much on the machines in use that it would be unwise to pass on without calling attention to the fact that the tactics must, of necessity, alter with the type of machine employed. The ideal machine for this work, of course, is one that is maneuverable, and that can be throttled down and at the same time made to fly level at any speed by means of an adjustable tail or other contrivance. With a machine of this nature, formation flying is very simple, as one can fly slowly until the actual combat or until necessity arises, when, by opening out the throttle, the necessary speed is obtained to launch the attack. Some machines, however, have motors that can not be throttled and tails that can not be adjusted, so formation flying becomes a greater problem.

IV.—Chains of Formation.

(a) The simple chain.

192. Aerial fighting has developed to that stage where it is necessary to send out formations and chains of formations for the accomplishment of missions. Mutual cooperation and support is essential. It has become necessary, therefore, to adopt a unit formation. The size of this unit varies and is determined by the simple fact that a flight leader can not control more than a limited number of machines in the air at one time with the greatest efficiency. It has become necessary, therefore, to send out chains of formations. Sometimes this chain consists merely of two formations, of three machines as a minimum, working in touch with one another; the front and lower formation guides, and may be called the front line; the rear formation conforms its movements to the lower and supports the lower in its attack, according to the requirements. They maintain their respective positions throughout the whole of an offensive patrol, and are often given definite patrols when it is necessary to cover a large amount of territory with a limited supply of machines. In such cases a patrol will be ordered to cover certain points at certain altitudes and at given times, and the two formations or echelons perform their mission, retaining their respective positions and relationship at all times.

193. It is interesting to compare this simple combination to a patrol on the ground. On the ground one would find advance and flank guards, but in the air these are unnecessary, and the work is accomplished by a top guard. The strength of this top guard has to be considerable, as this is the most vulnerable point of the formation, and great care has to be taken that it does not get too high nor too far in the rear of the main or guiding unit.

(b) Larger chains.

194. This simple chain can be augmented, as circumstances require, by increasing the number of each echelon or by adding one or more formations to the chain. The positions of the operation, and they have clearly defined functions to perform for each particular occasion that arises. For example, if three formations are patrolling, it is well to have them proceed in a triangular chain; the right rear formation serves as a support to the main body, while the left rear remains above in reserve to give protection during the combat and to deal with enemy machines that detach themselves and climb with the intention of counter attacking.

(c) Chains, at a distance from the airdromes.

195. This simple combination of formations is not the only kind of chain flying that has been developed. Sometimes individual formations are dispatched and they maintain their individuality and their independence until a given point is reached, at an appointed time, when they take up their positions with respect to the previously designated leading flight and proceed as in the simple chain. The advantage of these tactics for use against balloons or other localities of known enemy aerial activity, such as the rendezvous of a day bombardment formation, is obvious. It is well to point out in this particular form of tactics by chains of formations that the greatest care must be exercised by each leader of a formation. He must not give battle to any enemy aircraft before he reaches his objective and must sacrifice everything to being at his objective at the given instant. The importance of this can not be over emphasized, as failure on the part of even one formation leader might prove extremely disastrous.

(d) Chain.

196. These tactics can be employed at any altitude, but for low work prove especially valuable. These tactics have in mind at least three formations, one acting as the pivot. Each formation leaves the airdrome at a given time and proceeds over a prescribed route to a rendezvous. No time is lost in getting to the rendezvous, but each formation is independent until it connects with its pivot formation at that point. On arriving there the leader of the pivotal formation flies in an erratic course but on a definite bearing. The other formations, flying erratically, keep in touch, but practically out of sight of the pivot in the hope that the enemy may be encountered. Should one of these formations encounter enemy machines, a signal is given to summon the whole chain to its support. A chain of this kind is not liable to surprise, as the whole sky is under observation practically all the time and it becomes impossible for enemy formations to approach without being seen by some one. On the other hand, enemy aerial activity is almost bound to be observed by some one and by signals the hostile machines can be encountered and destroyed.

(e) Barrage chain.

197. These three formations of chain flying are used for offensive purposes. Pursuit aviation, however, is used a great deal for protection of reconnaissance and artillery observation machines. One of the simplest and most effective means of accomplishing this is by means of chains of formations. Each formation works individually, patrolling a given beat and connecting up at the extremities of the beat with its adjacent patrol. Each patrol in itself is irregular, in that it does not patrol the whole beat religiously, but proceeds erratically. In this way the aerial front line is maintained in advance of the lines of battle and friendly observation machines are permitted.
to carry out their important work of surveillance and observation unmolested. The utilization of permanent barrage chains is wearing on pilots and machines and is opposed to the principle of economy of forces, as it results in using up our available resources without permitting us to undertake those offensive expeditions in force which alone can cause maximum casualties to the enemy and give us a definite moral superiority. It should therefore be undertaken only at times of intense preparation for attack.

(f) Fighting tactics of the different chains.

198. The fighting tactics employed by the chains in actual combat have certain fundamental principles in common. In the attack the leaders, having done their utmost to surprise their adversary, swoop down deliberately on their opponent, relying on the support to lend necessary assistance. The latter at the same time acts as a reserve or top guard to deal with reinforcements which may arrive to assist the enemy. The primary object of the attack is to split up the enemy formation and enable the pilots of the patrol, maintaining superior altitude, to destroy the enemy in single combat. So much depends on the factor of surprise that its value can not be overestimated. Probably the best feature of a surprise attack is that the offensive formation maintains its unity, or at most, if it loses temporarily, regains more quickly, to great advantage in the ensuing combat which is bound to follow. Provision is always made for a rendezvous in case a formation is broken up. In practice it has been found that the center of the flight and the shortest line to our own side lines is the best rendezvous area. This not only enables a formation to get back quickly but often insures support of machines by one another on their return journey.

(g) Fighting tactics continued.

199. Fighting tactics in the chain depend a great deal on the machine, on the direction of the wind, and on the locality, but certain principles prevail in all combats which must be adhered to at all costs. First, the leader controls the situation. Every machine must conform to his movement and support him. Second, attempt must be made to fight outward at all times, the idea being to have your information intact at the end of the fight, with the enemy scattered on the outskirts. Thirdly, under no circumstances must a pilot or formation attempt to dive away from a fight. It is better for a pilot when his machine is shot to keep fighting and circling and be forced down in enemy territory than to attempt to break away and dive for home. By staying with the fight he lends support to his comrades and may cause the enemy to retire and enable himself and his comrades to reach safety after destroying enemy machines, whereas by diving for home he is practically certain to be shot down himself.

(h) Principles.

200. Certain principles in the fighting tactics must not be forgotten in the chain of formations. First, each formation must lend support to the other. Second, if given a mission to perform, a rendezvous or patrol, it must be carried out at all costs, as the success of the chain or formations depends so much on the carrying out of the mission by each individual formation. Third, each formation is subservient to the leading formation of the chain. The successful performance of the mission assigned to the chain is of a great deal more importance than any other that might be successfully accomplished by the single formation at the cost of the greater mission.

CHAPTER IV.—ATTACKS ON GROUND TARGETS.

201. Bombing and machine gunning of ground targets can be carried out only when air supremacy is attained. This supremacy does not have to be permanent, but must at least be temporary. Unless this supremacy is held at the time low flying is to be done, there will be a greater loss in machines than damage to the enemy. Ground straffs may be carried out in force by placing over the lines at a certain period a sufficient number of pursuit machines to establish the line of equal safety for machines as far over as the straffing is to be done. A single pilot of experience, however, may go over the enemy lines and ground straff when the enemy hold air supremacy, but the amount of possible damage he may do does not equal the risk for loss taken.

202. The discussion for low bombing and machine gunning can be combined, because where it is possible to accomplish one it is, as a rule, possible to accomplish the other. Low bombing, however, is more effective on troops. Bombing can be done from a greater height than effective machine gunning. Bombing is more effective on places of shelter. However, machine gunning done low straffing should be capable of both and in most cases a good target for low bombing is a good target for machine gunning.

203. Low straffing of ground targets is used only when large targets are available for attack. A target must be large enough to be an easy mark and important enough for its destruction to warrant the risk of loss of a machine. Only in time of great activity on the ground by either of the combatant forces are ground targets sufficiently large to warrant their being attacked from the air. In the ordinary course of war, when no offensive is being launched, a good target such as a staff car, or a convoy or a battery may occasionally present itself, and the pilot of a separate machine or a patrol leader of a formation may use his judgment as to whether the situation demands that he make an attack on that target. Although ground straffing is commonly spoken of as trench straffing, the term trench straffing is a misnomer. Targets in trenches are not large enough to straff from a height, and are protected; and if a machine goes down to within 25 or 30 feet from the ground, where many machine guns can be directed against it, the chance of that machine's doing damage is too small to offset the chance of its being brought down. When an offensive is under way, large bodies of troops, cavalry, and transport are being brought up to the line. These targets are large enough to spot from some distance in the air. Fire can be directed on the group and a great amount of material as well as material damage can be done to the enemy. Among targets which admit of attacks from the air are any groups of men or horses or transport of the enemy large enough to be easy of mark, and materials of any sort which are of military value and which can be destroyed by aerial attack.
204. The locality of effective ground straffing varies. As troops and transports approach the front line, there is a point where large movement can not be made. Back of that point is the beginning of the effective zone of ground straffing. The farther back of the line one goes, the larger are the bodies encountered. But after a certain distance the frequency of encounter will diminish. The zone for the best targets for ground straffing is that place where targets large enough to be easy of mark are found frequently. Besides the location of the target, the factor of comparative safety in distance of penetration enters the question. This factor is determined by the air superiority held, both permanent and temporary; upon weather conditions, the type of machine used, and the condition of enemy ground defense.

205. In conducting a ground straff the command has to consider the disposition of its forces and the method of their dispatch and orders. The disposition of forces depends upon the force available and the state of the attack. The dispatch and orders depend upon whether the target is predetermined and designated when the straffing machines leave the ground; or whether the target is to be found, the area in which targets are likely to appear being designated.

206. The problem of available force is one of the number of machines for ground straffing and the number for protective patrols. Whenever straffing is to be done there should be sufficient protective force above to make the low-flying machines safe from attack by enemy aircraft. If the protective force is insufficient a ground straffing machine will be easy prey for the enemy, because a pilot doing ground straffing has his attention centered on the ground and not in the air. Also formation of machines on this mission, in most cases, become scattered. The greater the confidence of the pilot of the low machine in the pilots protecting him, the better the job of ground straffing will be. Cooperation between the protecting machines and the straffing machines is very important. The feeling of personal relationship brings about the best cooperation, and patrols should be arranged to take the advantage of that fact, whenever possible. In case the number of machines for protection is small it will be necessary to concentrate the protecting force during certain hours and to send out all ground-straffing machines during these hours. If the number of machines available for protection is large, a barrage of machines may be kept up to serve as a protection at all times. It is more difficult to secure cooperation between the low-flying machines and the protecting machines where the protecting barrage of machines is used all day during the day than where forces are concentrated during limited periods. The number of machines available to do ground straffing does not affect their disposition so much as the number of the protecting force. The use of a ground straffing force, whether large or small, may be concentrated or extended according to the protective force available and the ground conditions.

207. The conditions on the ground which affect the dispatch of machines are the question of whether the attack is just beginning or is in steady slow progress. When the attack is in its first stages, machines should be sent over in great numbers and force should be concentrated in that period when greatest assistance can be rendered the ground troops. When the attack has slowed in progress, ground straffing may be extended for several days and a constant stream of machines kept over the enemy to harass his reserves coming up. The number over the lines at any time need not, however, be so great as when the attack is advancing rapidly. The purpose in putting a large number of straffing machines over when an attack is in its first stages is more a moral than a destructive aim. The sight of our machines straffing ground targets strengthens the morale of the friendly troops and weakens the morale of the enemy at a psychological moment. If an attack is slow in progress and ground straffing has been carried out day after day, the enemy must cease day movement of large bodies and transport must move in small groups, with some distance between groups. If it is found that insufficient ground targets are presented, it is well to concentrate on a certain period, and extend straffing farther back into enemy territory where large targets can be found. Also, the central control should know what cities and towns the enemy is using for concentration points and may designate special straffs on those centers at an unexpected time.

208. When machines are sent out for the purpose of attacking ground targets, the target may have been previously designated and information concerning its nature and its place given. Such a target is usually one of fleeting opportunity. In such a case it is necessary for the machines which are to make the attack to arrive at the place of the target upon very short notice. For the purpose of performing missions of this sort, certain squadrons should be moved to within the closest possible distance of the line, previous to an attack. A certain number of pilots and machines must be kept on alert constantly, ready to leave the ground at a moment's notice after information is received concerning a target. The machine used must be one which does not require warming, such as a rotary-motorized machine, in order that it may leave the ground immediately. Machines for this work can not go over the line farther than their protection takes them. If a protective barrage is up, the mission can be dispatched without special escort. If there is not protective force on the lines, a special escort must be provided.

209. A definite target, however, may be given which is not one of fleeting opportunity, such as a town where concentration is taking place, an important railroad, etc. Machines which are to perform the mission need not be from an advanced air drome. Targets of this nature are often given after a ground attack has been in progress for some time and when few moving targets worth while present themselves. However, the central control should know what centers are used for concentration points at all times and should direct attacks on them. These centers are usually too far over the lines for a low attack from the air to be carried out unless sufficient force is sent out as an escort to provide temporary air supremacy over the target. An enemy air drome presents a target of almost the same nature. Any target may be straffed from a low altitude, provided air superiority can be insured at the particular time and place.

210. Machines are also dispatched without particular targets being designated. The pilots may be instructed
only as to the locality in which targets are likely to be found. This is particularly true during the beginning of an attack on the enemy by ground troops. In such a case the central control should know the hour of attack, the lines of halting, the final objective, and the zone of exploitation. The pilots to do ground straffing should be informed of these various lines, and orders should be issued that up to a certain time targets will be attacked in a given zone and that after another definite time targets will be attacked in a definite zone farther within enemy territory. Unless this method is followed, pilots will not always be certain of whether targets are enemy or their own. But even if the progress is not so rapid, the central control must know the zone in which targets are likely to be found and must instruct pilots to look for them in that area. The more complete the information, the better will be results, for pilots should not have to spend much time looking for targets.

211. Whether machines are sent out singly, in pairs, or in a formation will depend entirely upon the situation. A small formation of three or five machines will bring best results in straffing most targets, because there will be a leader of some experience to find the target and to keep a lookout for enemy aircraft. Also, the formation will scatter the enemy fire from the ground. The formation cannot be large because of the danger of collision in getting at the target. Machines few in number can take turns attacking a target, but the number cannot be large because attack must be quick and machines must not have to wait for each other any length of time. If the target is surprised, fire from the ground will not be severe, but if time is given for the preparation, the chance of the loss of machines will be greater. The number of machines sent to attach the same target is, therefore, limited.

212. The pilots who are to do the ground straffing must possess very definite information as to where enemy troops are located and where friendly troops are located. Uncertainty, even to a limited extent, will ruin the efficiency of the work. In case the push is rapid and the line uncertain, the central control must inform the pilots of the limits of the zones in which straffing is to be done. Pilots should always be informed as to the latest line reports; and, if the line is a moving one, the pilot should know the line the infantry is supposed to hold at the precise moment attack is to be made from the air. Pilots after having this information should know their maps so well that reference to them is almost unnecessary. It is impracticable for pilots to determine whether troops are enemy or their own by uniforms, etc., before the attack from the air is made. To do this will do away with suddenness of attack, besides, in most cases, placing the pilot in unnecessary danger. There will, of course, be exceptional cases where pilots cannot tell by position whether troops are enemy, in which case they should make certain by uniforms and observation of various indicating facts before making an attack.

213. The method of actually straffing the target can not be prescribed. The closer a machine is to the ground, down to 100 feet, the more accurate will be the bombing and shooting; also the more accurate the fire from the enemy. Effective bombing and shooting can be done from 2,000 feet. The height from which work will be done will depend upon the development in types of machines and armament and on the effectiveness of the fire from the enemy.

214. Formations in an attack usually become very dispersed. If the nature of the target permits attack in formation, the airplanes of the formation should attack one after the other. In case the formation becomes completely scattered, pilots of inexperience should not remain over enemy territory a great length of time, for they are very subject to attack. The leader should, whenever possible, prescribe when withdrawal to the line is to be made, by signal to other machines. Otherwise, the machines should not linger over enemy territory longer than a few minutes. In case of complete dispersion each machine is to make its way back in the shortest line. If dispersion is only partial it is best to pick up the formation while withdrawing.

215. Weather conditions affect ground straffing fundamentally. Clouds may prohibit protective patrols. In this case ground straffing machines can not work in formations far over enemy territory, the distance depending, however, upon the height and nature of clouds, and visibility of atmosphere. A single machine may do effective ground straffing when coluds are under 2,000 feet, going to or returning from his target in the clouds. This is best accomplished when visibility is very poor, when there can be practically no enemy machines about. The most effective ground straffing done by single machines can be accomplished in weather of this sort, with very little danger of loss of the machine. The pilots must, however, be of experience.

216. The most difficult situations, however, arise when clouds exist at altitudes of about 2,000 feet, not rendering a protective patrol useless, but changing very greatly the cooperation between the protective patrol and the ground straffers, and rendering protection against attack from enemy aircraft much more difficult than where there are no clouds. If it is possible for machines to work above the low clouds, it is necessary to have part of the protective patrol above the clouds and part directly in touch with the ground straffers beneath the clouds. If it is impossible for machines to work above clouds, the protective patrol can not penetrate far into enemy territory, the distance depending upon the height of the clouds. The ground straffing machines, being lower, can work a little farther into enemy territory than the protective patrol is working.

217. Machines used in ground straffing can be combatd from the ground and from the air. The greatest source of destruction, however, comes from the ground, because of the greater possibilities of fire from that source, both with respect to accuracy and as to amount and kind. Also the sources of fire on the ground are difficult to observe, and can not easily be combated by the low-flying machine. It is necessary to perfect devices for fire from the ground and to provide machines which are to do low flying with a means of protection from enemy ground fire. When ground straffing is being done, it must also be combated from the air by low-flying machines with overhead protection.

218. The type of machine which is best adapted to ground straffing is necessarily an armored machine. As
weight is increased, maneuverability, speed, and climb will be decreased. The best machine will be the one with adequate armoring and with least decrease in maneuverability, speed, and climb, and with greatest reliability of engine. The reliability of the engine is more important in a ground strafing machine than in other types, because that machine usually works in a place where a forced landing means the loss of a machine and pilot. The engine least vulnerable to bullets is an air-cooled engine. Rotary motors can be shot through and still run. It is at present considered that the best type of machine for ground strafing is a single-seater, rotary-motorized, armored machine with two fields of fire—one in front and one below.

CHAPTER V.—ATTACKS ON BALLOONS.

219. Attacks on balloons may be divided into two general headings, one the individual unpremeditated attack, made merely because the pilot finds himself in position for such an attack after an engagement or some special mission, and, secondly, the scientific attacks, made with cooperation in various forms.

220. The first type is usually made with the utmost danger to the pilot, as he is open to attack by enemy aircraft from above and has no efficient method of stopping attack from the ground defenses. Those attacks should be discouraged save in very exceptional circumstances, when they should consist of a single dive, a long burst of machine-gun fire, continuing to an extremely short range, and then an immediate but cautious return to the lines. Organized balloon attacks often yield important results. They will almost always be undertaken just before or during an assault. In all attacks on balloons it is most essential that the gas bag be perforated in order that the gas may mix with the atmosphere and the incendiary ammunition ignite the resulting combustible mixture. It has been found satisfactory to use ordinary incendiary ammunition for the perforation of the bag, while a short burst of the incendiary ammunition fired at extremely short range, 25 to 50 yards, will in the majority of cases ignite the gas.

221. There are several methods of attacking a balloon. It should be kept clear in the minds of all pilots making such attacks that only approximately the front two-thirds of the bag has gas in it, the back one-third being filled largely with air. Because of this a vertical dive is not recommended. On the other hand, the pilot’s machine should be brought into such position that he will be firing parallel to the fore and aft axle of the balloon. This guarantees that the bullets will puncture the bag where the gas is located.

222. In a premeditated attack one of the elemental principles is to silence ground defenses in the shape of machine guns, “flaming onion” batteries (incendiary antiaircraft), and antiaircraft guns of greater caliber. This may be done either by our batteries or by aircraft accompanying the pilot who is to destroy the balloon. Both of these methods have proved very satisfactory in practice. In the first case the battery commander makes arrangements for his barrage to be directed at the winch and for a considerable radius surrounding the balloon. This barrage is usually laid down two or three minutes before the attack by our aircraft.

223. In the second case, the machine which is to destroy the balloon is accompanied by four or five other pursuit machines, fitted with bomb racks carrying light bombs. These bombs are dropped on the emplacements of the antiaircraft defenses and as close as possible to the winch. Immediately after this and at the same time that the single machine attacks the balloon, machine-gun fire is directed also at these ground defenses, and it has been found that the enemy in a considerable number of cases leaves his balloon up and takes cover.

224. Attacks on balloons should have as much of the element of surprise in their favor as conditions permit, in order to prevent the enemy from drawing his balloons to the ground before the attack is made. In case there are clouds in the sky, such cover as they afford should be utilized. On clear days great skill in maneuvering is necessary to make the balloon companies believe that the patrol has some other mission than destruction of the balloon. Very often a long, gentle glide to the enemy side of the balloon and considerably above it, followed by a steep, rapid dive and attack, will be successful. At other times it becomes necessary to follow the balloon as it is drawn to within a very short distance of the ground.

225. When more than one balloon is to be destroyed it is much more satisfactory, whenever possible, to assign patrols for the destruction of each target. In this way the element of surprise is maintained to a considerable degree. It is perfectly apparent that in the case of attack by one patrol on a number of balloons, the successful destruction of one will warn those to be attacked later of their danger, and will give them an opportunity to draw down the balloon and prepare for an intensive defense.

226. The element of surprise may be very valuable increased by making balloon attacks just at dawn or very late in the evening. Attack at this time also removes to a very large extent the danger of interference by hostile aircraft. The effect of an evening attack on a balloon line has really very little tactical or strategical value, as each balloon destroyed will be replaced in time for ascent on the following morning, but there is undoubtedly a considerable effect on morale, particularly in so far as observers are concerned.

227. It is exceedingly important that observers making successful descents in parachutes should be attacked, as they are extremely dangerous to our troops on the ground because of their training. Here again the question of morale arises, and if observers are attacked as they are descending in their parachutes, it is believed a considerable increase will be noted in the number of unnecessary descents made.

228. It has been found much more satisfactory to utilize the 11-millimeter machine gun than the ordinary caliber machine gun. Something on the order of the 1-pounder, firing a very delicately fused contact shell, would be even more successful for the destruction of enemy balloons. The use of bombs containing sulphur or other incendiary material did not prove satisfactory.

229. Whenever possible, balloon attacks should be made with an escort of considerable strength, in order to allow the attacking machines to perform their mission without interruption by enemy aircraft. This protection should be flying in the close vicinity of the balloon at the time.
of the attack, but at a higher altitude, and should be very
careful not to communicate to the enemy by its actions
prior to the attack information that the attack is being
made.

230. A considerable proportion of the balloon attacks
made by the Allies during the recent war failed in the
destruction of the balloon because the pilot did not have
a true appreciation of his distance from the balloon. This
realization of distance may be gained by practice with
balloons behind our lines, during the course of which
pilots will become familiar with the appearance of the bag
in the sight and will then be able to deliver the burst of
incendiary ammunition at a range short enough to be
efficient.

231. It should be the attempt of pursuit squadrons on
any front to keep the enemy balloons in their sector down
as much of the time as possible. Balloon observation is
extremely valuable for the regulation of artillery fire and
for reconnaissance of back areas. It is even suggested
that in the future night pursuit will be equipped with
searchlights or other means for locating and destroying
enemy balloons during darkness.

CHAPTER VI.—NIGHT PURSUIT.

232. With the development of the Air Service, the
problem of night flying and more particularly night pur­
suit has to be faced and solved.

233. At first sight it might appear that the limitations
of night pursuit are so great that such a squadron would
not justify its existence, but on more careful study one
finds that the possibilities are great and the possibilities
almost unlimited.

234. The main function of night pursuit at present is,
of course, defensive patrols for the purpose of destroying
night bombers. The British have already demonstrated
that this is practical.

235. There are many difficult problems in connection
with night pursuit that have to be answered before a
squadron can hope to meet with any success. The pilots
must be specially trained in navigation by night. This
can be learned in a very short time by one of ordinary
intelligence. Navigation by night can be helped greatly
by increasing the number of lighthouses, by mortar sig­
als, and by cooperation between the units of the Air
Service, day and night forces combined. Forced land­
ings at night discourage pilots more than any other feature
of this work, but with proper landing flares and emergency
airdrome lighting sets on all fields, and cooperation of
searchlights in the defended area, the dangers from this
source can be reduced to practically the same as in day
flying.

236. Pilots find that one of the greatest problems of
night pursuit is that of locating the enemy. They claim
that it is impossible to see him even with the aid of search­
lights. It is in fact difficult, but it is not impossible. On
moonlight nights the enemy is visible at 500 to 600 yards,
even when he is not in the beam of the light, and on bright
starlight nights he appears as a dark shadow at a distance of
200 yards. If he happens to be picked up by a search­
light, his planes show up for a very great distance, and
experience proves that sometimes machines can be held
in this beam for 10 minutes. Sometimes he can be seen,
not in the beam itself, but in the twilight formed in the
air by the searchlights, and flights have taken place
without the beam picking him up, or without the know­
ledge of the operators of the light.

237. As for the actual combat, it is safe to say that the
enemy can be engaged and brought down with slight
danger of his retaliation, provided he is seen first by the
pursuit pilot.

238. One of the great problems of night flying is equip­
ment. The necessities include first-class searchlights,
airplanes, airdromes, lighting plants, lighthouses, mortars,
and signals.

239. For night flying to prove a success in the operations
of an army, it is absolutely essential that it have the pro­
cper cooperation of and liaison with neighboring arms.
The searchlights are operated by the Corps of Engineers.
A liaison officer must be placed on the staff of the chief
of night flying who can advise and insure the proper
location of searchlights and the cooperation of their per­
sonnel with the pilots. The very closest liaison must be
maintained with the antiaircraft artillery. The chief of
the Air Service must have a liaison officer from this
branch on his staff and the guns must be located and
operated on his advice and with his cooperation. In
addition, official observation posts are to be established
in all units on the lines, each in touch with a post of com­
mand where there will be located a wireless transmitting
station, in order that the chief of all wireless stations in
the rear may be kept familiar with indications and loca­
tions of enemy aerial activity and likewise advised of its
cessation, so that he can most efficiently make his tactical
decisions.

240. Defended areas—that is, territory over which it is
forbidden to fly at night—should be reduced to a mini­
mum if not dispensed with entirely. Arrangements can
be made whereby all machines crossing the lines could
be challenged by the forward observation posts and the
identity of the machine fixed at this point.

241. It is very essential to obtain the proper kind of
machine for night work. In the first place, the engine
must be reliable, simple, and if possible, one that starts
up easily and instantly. Any reliable rotary or radial
motor seems best adapted for night pursuit. The machine
itself must be light, maneuverable, and possess great
flexibility of speed, owing to the tactical necessity, after
overturning a twin-engine machine, for a pilot to reduce
the speed to the same or less than that of the bomber. It
is essential that it climb and dive rapidly and at the same
time it should land very slowly, so that it can be safely
landed in a very small area, a feature that will always be
essential in night forced landings. It is well to strengthen
the center section struts and to take similar precautions
so that in case of a turnover the pilot can be sure of
getting out, and it is advisable to have a machine sensitive
laterally rather than fore and aft. If a machine is too
sensitive fore and aft, one is apt to dive into the ground
or stall on coming into the air drome, when one's atten­
tion is often diverted to landing lights, instruments, or
ground lights. With regard to fuel, it is advisable to
have as much gasoline as possible. Although a night
patrol should not be flown for more than 14 hours, pilote fre-
quently get lost returning and have to fly around a long
time before they get their bearings.

42. Armament is an important feature. Machines
should be equipped with two guns, one a balloon gun and
one ordinary. Sights should be illuminated and ordi-
nary ammunition used, with this exception, that very few
tracers should be used (1 in 15). Bomb racks are essential
with its bombs, and replaced on short notice, as normally
should be equipped with two guns, one a balloon gun and
its employment will not be the duty of night machines.

23. The instrument board is an important feature.
All instruments must be lighted and in addition luminous,
in themselves, and two movable flash-lights must be
provided, the whole electrical equipment being run from
two separate storage batteries which, in themselves,
should be very accessible, yet substantially fixed. A
good air speed indicator and a good altimeter are even
more essential in night flying than by day, and the com-
pass, too, must be of the very best. A machine will
carry wing tip flares, a navigation light on the outer
struts, and a signalling light on the bottom of the fuselage,
with at least one emergency parachute landing flare.
Normally the dangerous wing tip flares will not be used,
but in the case of forced landings these will be lighted,
sufficiently high above the ground to insure their being
burned out by the time the ground is reached. These
must be examined very frequently and under no cir-
cumstances should they be used later than the date
stamped thereon. There is no such word as economy in
connection with the use of flares. They must not be
opened until they are actually going to be placed on the machine.
First-class parachute flares should be the only
parachute flares carried. The signal light beneath the
fuselage must be operated by a tapper key and a perma-
nent switch be opened interchangeably, at will and
instantly.

24. Two kinds of airdrome equipment must be recog-

nized and provided: First, that in vogue on the fields
of the other night squadrons operating, which must be
most reliable and if necessary elaborate; secondly, the
emergency landing set, which should be at hand on these
fields but in addition should be placed on every airdrome
in the army area so that a pilot lost in a fog may with
safety call and land at any field. The arrangements of
the main fields must be worked out as circumstances
require, but it is essential that a good generating unit
be at hand and that the bounds of the field be clearly
defined. For an emergency lighting outfit, three small
concentrated beam-throwing lights, with power furnished
by a 15-volt storage battery placed on a trolley, are
recommended. These are inexpensive and on every
field will justify their existence many times over.

25. The army area as a whole must be lit up with
mortars and lighthouses and a 36° Sperry light at the
main airdrome, for the purpose of defense as well as for
the purpose of directing machines home, is essential.

26. Certain rules must be inaugurated for landing at
an airdrome at night. These must be formulated, not
forgetting the possibility of enemy bombing. They con-
sist of a signal for recognition and on the main fields the
use of a dummy airdrome as an adjunct. All pilots will
be called upon to make circuits to the left and glide in
parallel to the main line of lights. Each pilot must flash
the proper code letter before landing. If a crash blocks
the field proper, signals or a beam of light must be flashed
to him. In this connection it will be essential to instruct
and hold responsible one man at least on every field in
the best methods of placing the lights, so that a pilot
will never be required to come in over obstacles, and so
that he will be able to make a landing even if he is un-
familiar with the airdrome.

27. Probably the greatest difficulty to be encountered
is the selection of pilots for this work. It is absolutely
imperative that night pilots master the science of flying.
It is quite possible to be a pilot in the daytime and yet
know very little about flying, but he who hopes to suc-
ceed at night must be capable of flying any kind of
machine intuitively, and in addition must have mastered
the peculiarities of the particular machine that he is to use.
It is essential that he be keen about his work, and the
responsibility for this rests primarily with the squadron
commander, directly through the flight commander.
He must be imbued with a spirit of determination first
of all to develop this branch of aviation. He should be
steady, sober, keen, and industrious, and so fond of
flying that he seizes every opportunity to get up in the air,
day and night.

28. In flying a pursuit machine at night, a pilot who
has mastered his machine thoroughly should have no
difficulty in acquiring the art, whether pursuit or bomber,
but it is useless for him to attempt actual work until he
is adept. In all armies there have been regrettable acci-
dents in this connection which have tended to bring night
flying into disfavor with the pilots. It is a fact that any
good day pilot will make a good night pilot, provided
his vision is normal. In addition to being a good pilot
the night flyer must have a thorough knowledge of the
country, particularly of the landmarks. He must be
skilled in the location of possible fields, airdromes, forests,
rivers, bad ground, etc., and when he is first enlisted into
the service of a night squadron, he should utilize every
opportunity that presents itself of mastering the situa-
tion, never feeling satisfied until he knows the country
thoroughly. He must be instructed in cloud flying, but
should be warned never to attempt it unless compelled
to do so. If overtaken by a mist or clouds, he must
never let the ground get out of sight. If necessary he
should make a forced landing rather than attempt to get
home at night by flying through the mist, unless, of
course, he is flying high and is sure of the weather.

29. After a pilot becomes competent he will practice
forced landings on his own airdrome on moonlight nights,
and practice combat fighting with two-seaters at night
cooperating with the searchlights. Rehearsals of forced
landings by means of parachute flares are practicable,
the pilot using the engine if he discovers that the field sought
is likely to cause him to turn over.

30. The location of instruments and the method of
using them in the dark must become matters of second
nature to the night pilot, so that this will in no way
distract his attention from more important things. PatROLS will
often be monotonous, because they will cover short beats
over important points. Enemy night bombers are certain to follow permanent landmarks such as rivers or forests. This means that a pilot on patrol must stay over this spot patiently, and await his opportunity. He will do well to have patience and not to be distracted from his particular mission by neighboring lights. Pilots should never attempt to fly under 200 meters at night, as the risk involved is too great. On his first flight a pilot must arrive over his air-drome at a height of at least 1,000 meters and take his time coming in. The morale of pilots in all branches of the Air Service must be carefully preserved, but this is even more markedly true in the case of night pilots. Day flying should be permitted only between certain definite flying hours of daylight. Otherwise night pilots will never feel that they are off duty, and in a few weeks will become tired and disgusted with their work, and lose all their keenness.

251. The main duty in the operations of night pursuit is the defensive barrage. Patrols will be carefully planned, with the object of intercepting most bombers at the point where they are picked up by the searchlights. Patrols will therefore be carried out slightly in the rear of the line and more particularly over permanent landmarks. They will not last more than 14 hours and will vary in altitude from 2,000 to 4,000 meters, according to the situation. It is inadvisable to send patrols up until enemy activity has been reported by the advanced posts. It is possible to determine with great accuracy when the enemy is operating by observing his mortars, lighthouses, air-dromes, etc. Balloons may be utilized for this purpose, as they can render valuable assistance in it.

252. When a pilot is on patrol he will have his attention called to enemy aircraft by the firing of the "Archie" guns, by observation of the explosion of bombs on the ground, and by the direction and concentration of searchlight beams. He will "cut" his engine frequently and glide as long as possible with a dead engine so that the light operators and gunners can listen for the enemy planes. In time it will be possible to institute a system of rockets and flares which will enable a pilot on patrol to follow the course of an enemy bomber, and it is within the range of possibility that before long wireless telephones will come to the assistance of a pilot on patrol and solve many of his difficulties.

253. When a pilot sights an enemy machine, his simple tactics will be to get under his tail, closing in to a very close range and opening up fire after throttling down, making use of the element of surprise to the utmost, for if the enemy begins to side-slip and maneuver, he will probably get away. Should a pilot be so unfortunate as to be seen by the enemy machine before he has effected a complete surprise, he must endeavor to keep his eye on the enemy by observing his instrument board, his exhaust, or the explosive tracers from his machine guns. After a short time the enemy will steady down and probably attempt to dive for home, when it will be safe for the pursuit machine to close on him again. It is easier on a clear night to see machines above, silhouetted against the sky, but should he dive and get below the attacker, it is possible to pick up his outline once more against the lights on the ground; probably in time special illuminating lights will be provided for this purpose.

254. Other duties, however, besides these will be required of night pursuit squadrons. They will be required to attack balloons suspended in the air or lying on their beds late in the dusk of evening, after all the enemy airplanes have landed, thus enabling the pilot to come back unmolested and in safety to his own lines, landing after dark. In the early dawn the same work can be accomplished and it is not without the range of possibility that the efficiency of balloons will in this way be reduced.

255. Airdrome strafing in the late evening and in the early dawn is one of the chief functions of night pursuit and air-dromes may be so far back that the whole situation will be changed. Hangars probably will have to be underground and mechanics will have to live in dugouts. On fine nights single machines will harass enemy air-dromes many times over, and on some nights large offensive operations will be able to put many machines out of action. Before and during an offensive, enemy concentrations will be strafed and machine-gunned at night from a low altitude. The commanding officer of a night pursuit unit must be ready to develop the possibilities of his command to the utmost.

256. A great deal of the success of night pursuit will depend on the location of the air-drome. The ideal place is in the center of the line of searchlights. This enables pilots to stand on their air-dromes ready to take off, and reduce the duration of their patrols. With an air-drome in this location, pilots are able to go up and take short flights, making many sorties per night if necessary. Many devices, such as dummy air-dromes, must be used to enable the location of this advanced field to be kept secret and to prevent its being bombed. Machines will not be brought up until the night of an anticipated raid, the actual location of the squadron being well in the rear. As a matter of general principle, it is very much better, however, to have a squadron work from the field where its headquarters, hangars, machine shop, etc., are located, as advanced fields are never entirely satisfactory, and if at all practicable this should be the case. The location of this field near the searchlights, in addition to the usual advantages, keeps a possible landing ground within gliding distance of the pilot at all times and greatly increases his confidence and efficiency.

257. While it is important to have the air-dromes located centrally, the proper location of the searchlights is more essential, and two methods prevail: First, the concentration of searchlights around bombing objectives important from the enemy point of view, and second, the location of a continuous line of lights along the whole front. There are many points in favor of each, the ideal, of course, being the adoption of both. Certainly, it is best to have as many lights as possible, and in this the question of economy does not figure. Searchlights will be placed in units of three lights, in triangular formation, the sides of the triangle being roughly 300 yards. All the lights will be under the control of one P. C. and where possible this will be located on the air-drome and in direct touch with the operations officer of the squadron. Another very important feature about the location of the lights and one which will go a long way toward the success of the operations is that of possible "forced-landing" fields. Every searchlight, where possible, will be placed on a possible emergency
PART IV.—DAY BOMBARDMENT.

CHAPTER I.—SECURITY

260. The selection of an airdrome depends upon several circumstances, such as accessibility, distance from the front, size, security, and shelter. In day bombardment it is essential to select a large field. Airplanes loaded with bombs require a long runway to take off. As they climb slowly they must have considerable distance in which to attain sufficient altitude to clear the natural obstacles which generally surround a field. The necessity, especially during an offensive, to take off on short notice, requires the squadrons to leave the ground together. Therefore, a large airdrome is absolutely essential for the efficiency of the group.

261. Day bombardment airdromes as a general rule are situated at 35 kilometers from the front lines so that the airplanes may attain their bombarding altitude without making unnecessary detours before crossing the lines. Working within the limits above laid down, the selection of an airdrome, as regards security, should be made with consideration of the following principles:

The airdrome should be away from all landmarks which are visible at night, such as streams, intersecting highways, and large cities. An airdrome situated alongside a forest affords great security, as the hangars and buildings can be concealed among the trees. Care should be taken to place the camouflaged hangars on a well-defended edge of the forest. The colors of the hangars and other buildings blend well with the colors of the forest and it is difficult to locate the airdrome even in daylight, especially if the clouds are low and the known landmarks in the vicinity hidden. As most night raiders carry incendiary bombs, great care must be taken in choosing camouflage material and in the disposition of inflammables. The gasoline stores must be placed a safe distance from the hangars or other likely targets.

262. The distance of day bombardment airdromes from the front usually is a sufficient safeguard against daylight raids. But it is always well to organize a system of defense against low-flying enemy airplanes. This defense usually consists of machine-gun emplacements around the airdrome so placed that the enemy airplanes will have to pass through a barrage before reaching a bombing position over the hangars. At times the exigencies of the service make it necessary for day bombardment airdromes to be placed close to the front—as, for example, when operating in a constricted area. When airdromes are close to the front, earthworks and bombproof shelters must be erected around quarters as protection for the personnel against air raids and shell fire.

CHAPTER II.—ORDERS.

263. Chapter IV, Part I, applies.

CHAPTER III.—MARCHES AND CONVOYS.

264. Chapter V, Part I, applies.

CHAPTER IV.—GROUP ORGANIZATION.

265. Group commander.

Group operations officer.
Group adjutant.
Group armament officer.
Group supply officer.
Group instrument officer.
Group radio officer.
Group photographic officer.
Group officer in charge of flying field.
Group police officer.
Group surgeon.
Group transportation officer.

266. The efficiency of a group depends primarily upon the organization of its commissioned personnel. The principal duties of the group officers are here designated in order of importance.

267. Group commander.—The group commander has all the administrative duties of a post commander. He is responsible also for the operations of his group, the order for which he receives from the Army G-3 through the Army Air Service commander. In compliance with these operation orders he issues orders to his squadron commanders for the execution of the designated missions. Unless specifically covered in orders from higher authority the group commander's orders cover the following essentials:

(a) The number of formations and the number of airplanes in each.
(b) The types and weights of projectiles to be used.
(c) The time of departure, the order of departure of each formation, and the route, altitude, and time of arrival at objective. The duties of the group commander should be so coordinated that the minimum amount of time will be spent in the office. It is essential for him to keep in personal touch with all his squadron commanders and to create a feeling of sympathy with all his flying personnel. Flight commanders and leading observers should feel at liberty to make suggestions to him regarding changes in the execution of raids, which is possible only if he adopts an attitude of sympathy toward the elements of his command. He must make frequent visits to group commanders of the other branches of aviation, especially those of pursuit groups, as such conferences are the surest means of acquiring cooperation in aviation as a whole and of putting into effect in his group the best methods used by all the others. It is his duty to instruct his squadron commanders fully regarding the parts their respective squadrons will take in the raids. He must be a flying officer and should participate in such raids as his duties will permit. It is absolutely essential for him to participate in sufficient raids over the lines in order that he may be familiar with the actual execution of bombing raids. With the development of the wireless telephone he will be able to direct the execution of a bombing raid from a point of vantage impossible to a formation leader.

268. Operations officer.—The operations officer will carry out the will of the group commander much the same as an adjutant does that of a post commander. He should be chosen for his executive ability—preferably a leading observer who has had considerable experience over the lines. He will have immediate supervision of group operations. It is his duty—

(a) To compile and keep available for the group commander all information of value in the preparation of bombing raids.

(b) To keep an indexed file of photographs and a supply of maps for the pilots and observers. He will post in the operations room a map of the sector (1 to 60,000 or 1 to 50,000 scales) in which the group is operating; also a map (1 to 200,000) showing the lines of the entire front, with the changes as they occur. For the instruction of the flying personnel he will post maps upon which are indicated the location of all antiaircraft batteries, airfields, artillery positions, hospitals, and balloons, both our own and those of the enemy.

(c) To post on a bulletin board all orders and communications and all bulletins of the Army, Army corps, and divisions which may be of interest to pilots and observers of the group.

(d) To transmit all information obtained from squadron operations officers to the Army Air Service commander and to file the raid reports of each squadron with the records of the group.

(e) To supervise the work of the group photographic officer, to see that all possible photographs of the raids are taken and proper distribution of the prints made.

(f) To supervise the work of group pilot and observer detailed to instruct new pilots and observers in the theory and practice of bombing.

(g) To instruct selected officers in the duties of the operations office, to supply operations officers to new squadrons.

(h) To post silhouettes of all types of our own and enemy airplanes in places where they can be studied by all pilots and observers.

(i) To keep in touch with the meteorological station, and to post at least twice daily the reports on weather and air conditions.

The group operations officer should keep intelligence charts showing all the bombing objectives, and mark daily on duplicate copies the bombardments effected. He should keep to date all information of the number and type of enemy aircraft in the sector, their air tactics, and the best methods to combat them. He is responsible for the correct interpretations of the photographs taken by the group, and for utilizing the information thus obtained. He is further responsible for the establishment and maintenance of internal liaison, liaison with G-2 Army, A. S. S. C., and all the pursuit wings and other groups.

269. Armament officer.—The duties of the group armament officer are:

(a) To exercise general supervision over the entire armament of the group.

(b) To advise the group commander on the best types of bombs available for a particular purpose.

(c) To maintain a close liaison with the ordnance department so that the squadrons may obtain, at the earliest date possible, any improvements in bombs, ammunition, guns, or armor.

(d) To maintain a personal liaison with the armament officers of all aviation units, and to take advantage of the improvements evolved by them.

(e) To advise the supply officer of the needs of the group in armament, and see that requisitions are made out to supply them.

The duties of the armament officer are very important in the group. He is responsible for the storing and care of explosives, and for the protection of the airplanes against incendiary bullets in combat. He should be an officer of great initiative, as most of the improvements in armament will be developed from suggestions made by him to the ordnance department. Nearly all real and effective improvements result from experience gained at the front.

270. Supply officer.—The main duty of the group supply officer is to keep on hand an adequate but not an excessive supply of spare parts. Enough spare parts are necessary to permit the group to operate at maximum efficiency; an oversupply decreases the mobility of the unit when ordered to move. It requires a constant study of the spare parts used by the group to estimate the amount necessary. To prevent an overaccumulation of spare parts, the group supply officer must supervise the work of the squadron supply officers and issue spare parts to the squadron only when actually needed for particular repairs. By personal visits to the parks he can learn what supplies are on hand, and what expected, and thus avoid submitting many useless requisitions.

271. Instrument officer.—The duties of the instrument officer are:

(a) To keep in adjustment all delicate instruments used in bombing.

(b) To keep up-to-date information on the manufacture and improvement of such instruments.

(c) To recommend improvements in the instrument, and requisition new or improved types.
272. Radio officer.—The duties of the group radio officer are:

(a) To supervise the installation and testing of all radio equipment.
(b) To install and test all radio telephones.
(c) To operate the radio station.
(d) To carry out orders from the group operations officer in establishing liaison with all other radio stations at the front.

273. Photographic officer.—The duties of the group photographic officer are:

(a) To command the photograph section.
(b) To supervise the care and installation in the airplanes of all the cameras.
(c) To see that all plates are properly developed and prints made.
(d) To see that all prints are properly marked.
(e) To make the correct interpretations of the photographs.
(f) To see that the observers are efficient in the manipulation of the cameras.
(g) To collect all the cameras after a raid, and to assume responsibility for the plates exposed by the observers.

274. Officer in charge of flying field.—The officer in charge of the flying field is responsible for discipline on the field. His duties include the following:

(a) That pilots comply strictly with the rules for taking off and landing, and for piloting while in the air.
(b) That the sleeves are properly placed and working all the time.
(c) That the landing T is always out in the daytime and indicates exactly the direction of the wind.
(d) That flares and landing lights are ready and properly placed to aid airplanes landing after night has fallen.
(e) That all wrecked airplanes are removed from the airfield without delay.
(f) To superintend the maintenance of the terrain of the airfield so that the field be in the best possible condition for airplanes to take off and land.
(g) To see that airplanes parked outside the hangars are properly aligned.

The officer in charge of the flying field has a very important effect on the proper functioning of the group. His discipline must be very strict. Many infractions of the field rules are made by pilots returning from a raid in which the airplanes have suffered from antiaircraft or enemy airplane attacks. The officer in charge of the flying field must report every breach of discipline to the group commander. There is a tendency for the group commander to overlook breaches of discipline when there has been a severe combat, but the field officer must enforce the flying rules as safeguard against accidents. The officer in charge of the flying field also assumes command of the ground targets for aerial gunnery. He should see that the targets are properly placed and danger flags set up during practice.

275. Police officer.—The police officer can be given the odd jobs which may not seem important but which must be done for the proper maintenance of the group when operating against the enemy. It is his duty:

(a) To see that the camp is kept clean.
(b) To see that all oil, gasoline drums, and other material which can not be sheltered are properly placed and neatly arranged.
(c) To see that necessary walks are laid out and maintained.
(d) To take proper precautions to protect the camp against fire and to see that fire-fighting facilities are maintained.
(e) To see that the enlisted personnel use the latrines ordered by the surgeon; when a group occupies an airfield temporarily it is difficult to make the enlisted personnel observe this regulation.
(f) To see that an airfield when evacuated is left in proper condition.

276. Surgeon.—The surgeon cares for the health and sanitation of the group. Close supervision of the group surgeon by the group commander is necessary. He should have a comfortable building as a hospital in which to treat flying personnel suffering from only temporary ailments. There is a tendency on the part of most group surgeons to evacuate pilots and observers for a month or more for slight indispositions which could be cured in three days at the group hospital.

The group surgeon will see that a medical officer is on duty during flying hours and an ambulance with a driver on the field.

277. Group transportation officer.—The principal duty of the group transportation officer is the care of all transportation.

(a) He will make requisition on the group supply officer for all transportation and spare parts needed.
(b) He will supervise the employment of the transportation in all marches and convoys.
(c) He will see that his chauffeurs are properly instructed in all traffic regulations.
(d) He will see that his enlisted personnel is properly instructed in the care and upkeep of all motor vehicles.
(e) He will see that no transportation is driven from the park that is not in proper condition.
(f) He will be directly under the supervision of the group commander, and will assign no transportation without his consent.

278. Group adjutant.—The group adjutant will carry out the administrative duties of the group and will bear the same relation to the group commander that the adjutant of a post does to the post commander.

CHAPTER V.—THE SQUADRON.

279. Squadron commander.

Adjutant.
Operations officer.
Ordnance officer.
Engineer officer.
Supply officer.

280. The squadron commander is responsible for the operations of his squadron. He should be a natural leader of men. His squadron will have no more initiative than he personally shows, nor will the morale of his command be higher than his own. He must be a flying officer and must so perfect his organization as to have time to lead frequent raids. His adjutant must be capable of looking after the
preparation for raids. A squadron commander should be chosen from the best flight leaders gifted with executive ability. His more specific duties are:

(a) To issue orders necessary for the execution of missions.
(b) To give special instruction to his flight leaders on points not covered by the operations officer.
(c) To give personal instruction to his flying personnel on the tactics employed in the execution of missions.
(d) To acquire sufficient intimacy with his flying officers to enable him judiciously to select pilots and observers for special missions.

281. Adjutant.—To the adjutant fall the administrative duties of the squadron.

282. Operations officer.—The duties of operations officer include:

(a) To compile and keep available for the squadron commander and flying personnel all information of value in the preparation for bombing raids.
(b) To keep an indexed file of photographs, and a supply of maps for pilots and observers. He will post in the operations room a map of the sector (1 to 80,000 or 1 to 50,000 scale), in which the squadron is operating; also a map (1 to 200,000) showing the lines of the entire front, with the changes as they occur. For the instruction of the flying personnel he will post maps upon which are indicated the location of all antiaircraft batteries, airfields, artillery positions, hospitals, and balloons, both our own and those of the enemy.
(c) To make proper preparations for all the raids.
(d) To compile all information submitted by pilots and observers returning from a raid and make written report thereof to the group-operations officer.
(e) To see that the orders of the squadron commander are transmitted to the flying personnel.
(f) To maintain an operations room similar to that of the group-operations officers.

283. Ordnance officer.—The ordnance officer is under the supervision of the group-armament officer, and is responsible for the armament of the squadron. His duties are:

(a) To test and calibrate all ammunition.
(b) To supervise the care of all machine guns.
(c) To synchronize all machine guns mounted to shoot through the propeller and to adjust all sights.
(d) To supervise the placing of the bombs on all airplanes scheduled for raids.
(e) To see that all bomb sights and bomb racks function properly.
(f) To test all pyrotechnics.
(g) To care for all the explosives in the squadron.
(h) To see that all machine guns mounted for a raid function properly.

284. Engineer officer.—The engineer officer has supervision of all the airplanes, spare parts, and the E. and R. shops. His duties are:

(a) To supervise the overhauling of all motors and the aligning of all airplanes and to make all necessary repairs.

285. Supply officer.—The duties of the squadron supply officer are:

(a) To take charge of squadron stores and supplies.
(b) To make necessary requisitions to the group supply officer for supplies needed in the operations of the squadron.

CHAPTER VI.—PRELIMINARY TRAINING AT THE FRONT.

286. No matter how thorough the course of training given at the instruction centers, no bombardment unit is prepared to begin actual operations against the enemy when it arrives at the front. The knowledge that the enemy is but 20 minutes away brings home to the pilots and observers the realities of war. Flying behind the lines, and a short review of the things they have learned at training schools, soon impress them with these realities, and lead to rapid and real preparation for work over the lines.

287. The pilots and observers will be given a review of their theoretical course of instruction to ascertain their fitness for further service. If their previous training is found to be sufficient they will be taught from maps the exact location of the lines, and all the topographical features of the sector. Special attention will be directed to prominent landmarks. They will acquaint themselves with the positions of all our troops and of our antiaircraft batteries, as well as those of the enemy. They must learn the location of all bombing objectives and be able to identify them from photographs. They must be able to identify at a glance silhouettes of all our own and enemy airplanes. They will be given instruction in the enemy methods of attack and our tactics for defense. Formation flights will be made every day, approaching nearer to the lines. Pilots and observers who are paired off in teams will always fly together when possible. They should live together in the same quarters, and know each other intimately. On the practice flights the pilots will be given an objective, and the time will be fixed for leaving the ground and bombing the target. The formation will pass over the flying field at a given altitude for inspection by the commanding officer.

288. When the flight returns to the airdrome the signal to break formation will be given by the leading observer. The pilots will obey the rules of the flying field, landing with the T. and in rotation. This practice will be continued until the pilots and observers know the sector perfectly, and can adhere to the time schedule while flying tight formation with a full load of bombs. The observers will make observations, practice signals with Very pistols, take photographs, and submit raid reports to the operations officer immediately after landing. During this period the pilots and observers will be given instructions in aerial gunnery with shooting practice at ground targets. The observers must become expert machine gunners to be successful in combat with hostile aircraft. This training will give the squadron commander an opportunity to select his flight leaders, and the observers who are to specialize in photography, reconnaissance, and protection.

289. Leading observers will be chosen from those making the best records at the bombing schools. After operations have begun other observers will be given opportunity to qualify in leading. Some observers make excellent records in training centers, but fail in duty over the lines, and vice versa. After this training the squadron will be ready to begin real operations. Large targets which are close to the lines and easy to hit should be chosen as objectives for the first raids.
CHAPTER VII.—PREPARATION FOR A RAID.

290. Day bombardment objectives will be designated by G-3 of the Army, and orders transmitted through the Army Air Service commander to the commander of the group. Upon receipt of these orders he will decide upon the following:

(a) The number of formations and the number of airplanes in each.
(b) The types and weights of projectiles to be carried.
(c) The route, altitude, and time of departure and arrival over the objective of each formation.
(d) The method of pursuit cooperation.

The pilots and observers must be allowed ample time to acquaint themselves with all available information regarding the objectives, both primary and secondary, the route, and the region to be observed and photographed. The squadron commanders will designate the pilots and observers who are to participate in the raid, and are responsible for their preparation for the execution of the mission. They will designate the flight leaders and deputy flight leaders, and will assign positions in the formation to the rest of the teams scheduled for the raid. The squadron operations officers will then prepare the operation order, a copy of which will be sent to the group operations officer.

291. The formations.—Day bombardment squadrons will invariably work in formation. The formation should be large, as many as 18 airplanes being easily controlled by a leader when working at high altitudes. For low flying formations in bad weather, 8 is the maximum that can be employed. All formations must have the following characteristics:

(a) Simplicity.
(b) No dead angles.
(c) Concentration of fire to the rear.
(d) Concentration of fire below the center of the formation.
(e) Compactness.
(f) Each airplane must be able to see the leader.

All formations, whatever the number, should fly in a V formation with the rear of the V closed. Formations of more than 10 should have one airplane in the center of the V at the average altitude of the V. Airplanes in formation should be numbered as follows:

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No. 1 is the leader and flies at the lowest altitude; Nos. 2 and 3, 4 and 5, and similarly placed pairs should fly at the same altitude; Nos. 2 and 3 about 50 meters higher than No. 1, and about 30 meters to the right and left of No. 1, respectively. No. 4 takes the same position relative to No. 2, and No. 2 with reference to No. 1; and No. 5 takes the same position with relation to No. 3.

Formations should be as compact as possible, especially when dropping projectiles; during a combat, formations should close up. Too much emphasis can not be laid upon the training of day bombardment pilots in formation flying.

If the pilots maintain a regular echelonment in height, in case of emergency they can close up quickly upon the leader, by diving. The leader should never open his throttle wide, and observers should always warn their pilots whenever their own or any other airplane appears to be getting out of formation. It is fatal for an airplane to leave the formation, and the formation should not be broken up to protect an airplane which has dropped out.

292. The take-off.—The pilots and observers should be in readiness on the field at least 30 minutes before the formation is scheduled to leave the ground, reporting to their respective operations officers. This will give the operations officers time to replace any unavailable pilots or observers. The pilots will utilize this time to make a thorough inspection of their airplanes and test their engines, and the observers to arrange their maps, Very pistols, and ammunition drums, and to inspect their machine guns. If the flying field is sufficiently large the formation will be assembled on the ground. The flight leader and pilots 2 and 3 leave the ground simultaneously; 4 and 5 will start as soon as the wheels' of 2 and 3 are in the air, and so on until the whole formation is in flight. The leader will throttle down as soon as he has attained sufficient altitude to do so with safety. When all the airplanes are in position the flight leader may take up traveling speed in climbing, but never full speed. The only practicable formation maneuver is a figure 8 on a wide circuit of about 5 kilometers.

293. Flight to the objective.—The formation will attain an altitude of 1,000 meters in the vicinity of the airdrome, and then upon the signal of one white star from the leading airplane, follow the prescribed course to the lines. The bombing altitudes, generally 4,000 meters or higher, must be attained before the formation is within 5 kilometers of the lines, in order that the leading observer may make the calculations necessary for the adjustments of his sight without being molested by antiaircraft fire or enemy airplanes. The target may be approached either up or down wind. The formation should be tight upon crossing the lines. Any airplane which can not hold its position in the formation must return to the airdrome.

294. Bombing the objective.—When nearing the objective the leading observer will steer his pilot by means of reins attached to the pilot's arms. This is necessary because the pilot has a limited vision of objects directly under his airplane. The leading observer should recheck his calculations, and then fire the "prepare to bomb" signal of six green stars. When the image of the target appears in the line of sight of the bomb sight he will pull the bomb-dropping lever. All other observers, or pilots, as the case may be, will release their bombs the moment those of the leading airplane are seen to leave the racks. Great accuracy has been obtained by using this method of bombing. Precision bombing over the lines is an art in which only a few observers excel. Such observers should be chosen for leading or deputy positions. Bomb sighting requires cool judgment and intensive observation of the target. Excitement causes inaccuracies. If but one observer does the sighting, he knows that all the others are acting as protection, and his excitement is thus lessened.

295. When several formations are sent to attack the same objective they should bomb at 30-second intervals. Upon
leaving the objective they should all turn in the same direction. In the performance of a day bombardment mission it is essential that the formations reach the objectives exactly on time in order that successful cooperation with the pursuit units designated may be assured. With successful pursuit cooperation great damage can be inflicted upon the enemy with minimum losses to both day bombardment and pursuit.

296. *The return route.*—To spend the minimum amount of time over hostile territory is the aim of every formation leader. The route from the objective back to the lines must be chosen with consideration of the direction of the wind, the position of the sun, the location of cloud banks, the most accurate enemy antiaircraft batteries, and the probable direction of attack by enemy aircraft. If the presence of hostile aircraft does not make it inadvisable, the formation leader should always take advantage of the wind to regain the lines. It is sometimes advisable to fly toward the sun, and thus put the enemy under the disadvantage of facing the strong light. The leader should avoid passing under clouds which offer concealment to hostile airplanes. Clouds under the formation or at the same level may be utilized for protection. Frequent changes of direction should be made, but they should be made slowly. Rapid changes of direction may cause a rear airplane to lag, which usually results in its destruction. Speed does not enter very much into the safe return of the formation. The formation should be so formed as to afford no vulnerable point of attack, as its safety depends upon its fire superiority.

297. *Breaking formation and landing.*—Having recrossed the lines beyond which enemy pursuit airplanes seldom venture the formation leader begins a long glide toward the airdrome. When nearing the landing field the leading observer fires a green rocket as a signal to break formation. The airplanes circle the airdrome and land according to number in formation, No. 1 first, followed by No. 2, and so on. All airplanes land into the wind, as indicated by the T. The landing rules must be strictly observed. The observers and pilots report immediately to their respective operations officers on the field, and submit written raid reports, which include results of the bombardment, observations of enemy movements on the ground and in the air, the number of enemy airplanes brought down, and our own losses.

298. *Low bombing raids.*—At the beginning of an advance or during an offensive, by either friendly or hostile troops, there are occasions when day bombardment must resort to low bombing. These occasions arise when the weather conditions are such that altitude cannot be attained to carry out the imperative bombardments, or when, for instance, certain bridges must be destroyed, but the topographical features around the objective make it impossible for artillery fire to accomplish that destruction. Day bombardment must be used at low altitudes against such objectives.

299. The time element often prevents the accomplishment of such missions. The day bombardment airdromes are at a considerable distance from the front lines, and time is required for transmitting the information and for warming up the high-powered engines. Often the conditions have changed before the bombers arrive at the objective. A heavily loaded bombing airplane is slow in climbing and maneuvers, and therefore unsuited for this kind of work. The best type of airplane for low bombing is one that can climb and maneuver quickly. The rotary engine, which is air cooled and can be started very readily and which continues to run after being hit by enemy bullets and would, therefore, be better than the fixed motor for low bombing.

300. When orders are received for a low-bombing mission the group commander decides the number of airplanes to be sent in formation, never more than six. Great care should be taken in selecting the leader. He should be daring and know the terrain perfectly and the exact location of our own troops. The pilots should be chosen for their skill and daring, as there is always danger of collisions when the bombers operate at very low altitudes. When descending to bomb the pilots should 'straf' the objective, to demoralize the enemy and prevent accurate fire from the ground. The observers use their machine guns before and after they have released the bombs.

CHAPTER VIII.—COMBAT.

301. *General principles.*—The three general tactical principles, in order of their importance, are:

1. The effective bombing of the objective.
2. The reduction of our losses to a minimum.
3. The inflicting of the greatest possible losses on enemy aviation.

Tactics of day bombardment in combat are, therefore, defensive. Owing to the size of a bombing formation, and the slow maneuvers necessary, quick changes of direction and steep dives are impracticable. The bombers must depend upon the nature of their formation, which should be such as to give them fire superiority. The formation should have symmetry, simplicity, and compactness, with no dead angles, and should permit a concentration of fire to the rear and below the center. Each pilot must be able to see the leader. A formation so formed, with well-trained pilot and observers, can defend itself against superior numbers of the enemy.

302. *Formation leader.*—A formation leader to be successful must have the absolute confidence of his pilots and observers. Under definite orders at all times, much depends upon his quick decisions and accurate estimate of tactical situations. The tactical situation often changes his plans. The appearance of cloud banks, a change in the direction of the wind, a sudden burst of sunlight, or new methods of attack by the enemy make it imperative for him to think and act quickly to carry out his mission in the face of altered conditions. He must know just what reliance can be placed on each pilot. He must so arrange his pilots, and the chain of responsibility in the formation, that no matter how great the losses incurred the formation will preserve its unity. He must be a model of discipline, and enforce the same from his pilots. Though tempting aircraft targets often appear he must remember that the safety of the formation depends upon its unity, and neither he nor any other pilot should break formation to attack individually. He must sacrifice chances for personal glory in combat to the object of his mission, which is to reach and bomb the objective and return without loss.
303. Enemy methods of attack.—The deciding element in aerial combat is usually surprise. The enemy will employ all means at his disposal to conceal his approach. His most usual methods are to climb into the sun, and approach from that direction with the advantage of light and altitude. When the enemy gets between a formation and the sun he often escapes detection until he actually opens fire. He will also take advantage of cloud banks to screen his approach. Sometimes, when operating as a chain, one flight of enemy pursuit airplanes will follow the bombers to attract their attention, while other flights approach unnoticed. His aim is to break up the formation, or at least isolate several of the bombers, and then by concentration to destroy them. Sometimes a single enemy pursuit airplane will fly below and in front of the formation in an attempt to entice a bombing pilot to dive at him. Other enemy airplanes, at greater altitudes, will immediately dive on the bomber, thus separating him from the formation.

304. Having decided to attack, several of the enemy usually approach from the rear and open fire at about 200 meters. While the observers are engaged with these at the rear, other attacking airplanes will dive under the formation and attack from the dead angle under the tail. This attack is usually directed at the airplanes at the rear of the formation. Other airplanes will dive rapidly at either side of the formation and rake the whole arm of the V with deflection fire. One, or perhaps two, will try to shoot down the leader, and thus break up the formation. Occasionally, when the enemy has vastly superior numbers, he will make a determined rush at the formation. This attack, when made by experienced pilots, is very hard to combat, especially if the bombers are inexperienced. An enemy formation sometimes flies parallel to the bombing formation, at a slightly greater altitude. In an attack of this kind the individual pilots make sudden dives at the flanks of the bombers, deliver their bursts, and then wing-slip to safety before regaining their positions alongside and above the formation.

305. Methods of defense.—The observer first to sight enemy airplanes fires a rocket of six red stars. The formation tightens up, and the observers fire at the nearest enemy airplane. Fire is concentrated upon the leading airplanes until they turn back, or are brought down. When this is accomplished, fire is brought to bear on the enemy airplanes which venture closest to the formation. During a combat the pilots watch the progress of the fighting by means of mirrors, and endeavor to maneuver their airplanes into firing positions best for the observers, and at the same time keep their places in formation. The formation leader maneuvers to take advantage of the wind, clouds, and sunlight. He should never increase the formation speed beyond that possible to the slowest airplane in the formation. In a group operation he will lead his formation so the guns of the other formations can be brought to bear on the enemy. The leaders of the other formations will maneuver to conform to the necessities of group protection. If an observer has his guns completely jammed, or if he is too badly wounded to open his guns, the pilot will fly directly below the leader for protection. If a motor is put out of commission, the pilot will attempt to regain the lines. The leader can sometimes maneuver the formation to protect a pilot who has been forced to drop out, but no pilot will leave the formation for that purpose. The leader must always be in mind the prearranged cooperation with the pursuit, and try to lead the enemy toward the rendezvous. Other airplanes can inflict great losses by attacking when the enemy is engaged with the enemy is engaged with the enemy.

306. Tactics of a single two-seater.—When a bombing airplane becomes separated from the formation, the pilot and observer generally have to fight their way back to the lines. A large bombing formation attracts enemy pursuit airplanes from over a wide area. Pilots with motor trouble, or forced to drop behind because of broken control wires, are attacked by enemy aircraft from the main combat as well as those which were too late to attack the formation properly. When thus attacked, the pilot must fly an irregular course. He must give his observer every chance to fire bursts at favorable targets, and try to reach the lines as quickly as possible. If the attacking airplanes are numerous, and the pilot, considering the disability of his airplane, sees no chance to cut his way through, it is well to make a tight spiral in descending. Often a pilot can risk the accuracy of ground fire if such a maneuver would throw off the attacking airplanes.

PART V.—CAPTIVE BALLOONS.

CHAPTER I.—ORGANIZATION.

307. The Mobile Army.—There should be a balloon company for each division, one for each corps, and three companies as reserve balloons for each army. These companies should be completely motorized, in order to assure efficient functioning with the elements of the army with which they are working.

308. Tables of Organization.—The details of organization, the amounts and kinds of transportation, and the factors on which the allowance of transportation is based are fixed on the Tables of Organization, Air Service, United States Army.

Within a corps, a balloon company should be assigned to each division and one to the corps. These assignments should be permanent, or at least continue while the divisions are with the corps, so that perfect liaison can be established.

CHAPTER II.—INFORMATION.

309. Information collected in time of peace.—This consists of a study of maps, of types of balloons and airplanes of our own and other nations, and of such other information as is available.

310. Information obtained in time of hostilities.—This consists of all information gathered during hostilities by balloon companies at the front. In general, this information is only that which is obtained from the basket, relative to troop movements, destructions, enemy batteries, infantry actions, information on our own artillery fire, flares, explosions, fires, etc. This information is transmitted to the Information and Operation Sections of the General Staff of the unit with which the balloon is working. The means of communication is usually the telephone, but in the event of the failure of this means recourse is had to radiotelegraphy, radiotelephony, visual signaling, or runner.
311. The only reconnaissance which balloon personnel is called upon to make is that by balloon observers in airplanes, to make themselves more familiar with the immediate field of operations.

312. Reports.—In addition to routine administrative reports, the following reports are submitted:

(a) By balloon companies to group headquarters.
1. Daily balloon company reports.
2. Observers' ascent report.
(b) By balloon group to balloon wing, and to general staff of unit with which employed.
1. Daily balloon group report.
(c) By balloon wing to Army Air Service Operations Section.
1. Daily balloon wing report.

CHAPTER III.—SECURITY.

313. Security embraces all those measures taken by a balloon company to protect itself from observation, annoyance, or surprise by the enemy.

(a) From observation: This consists of all the ordinary precautions taken by troops in the field to prevent observation by the enemy. It consists further of all possible efforts to conceal the position of the balloon bed. This is effected by choosing deflated positions which are concealed also by overhead screens, such as trees, vines, etc. It is further effected by the use of vari-colored camouflage balloon fabric. When the balloon is out of its bed, great care should always be taken to leave nothing in the vicinity of the bed which would disclose its position. All machine gun and automatic cannon positions should be screened from observation. When the balloon is in the air, screening from aerial observation should be provided for the winch, tender, and personnel. These points can not be too highly emphasized, as they are vitally essential to uninterrupted functioning.

(b) From annoyance: This consists of an equipment of machine guns and automatic cannon on antiaircraft mounts, manned by experienced personnel. As the chief source of annoyance by the enemy is their airplanes, specialists are trained in balloon companies whose only duties are to study continuously type of airplanes and to watch the sky for them. These lookout and the antiaircraft armament personnel must be highly trained. Furthermore, balloon company commanders must always arrange to have at least one antiaircraft artillery battery within protective radius.

(c) From surprise: This consists of the usual precautions against surprise, as well as the proper training and functioning of lookouts.

CHAPTER IV.—MARCHES.

314. A successful march, whether in peace or war, is one that places the company at its destination at the proper moment and in the best possible condition. In war, marches are of frequent occurrence, and success depends in a great measure upon the skill with which they are conducted. Balloon companies, being completely motorized, move always as a motor train.

315. Two types of marches are undertaken by balloon companies: Those with balloon inflated and those with balloon packed. Marches with the balloon packed follow the rules and regulations prescribed for motor trains. The rate and length of marches with the balloon inflated depend entirely on the tactical situation. The rate is dependent only on the rate of travel of the winch transporting the balloon.

316. The most common forms of obstacles encountered during a march with the balloon inflated are wires crossing the road, camouflaging crossing the road, trees bordering the road, and tall buildings on narrow streets in villages. Wires may be either insulated or high tension, and radio antennae are sometimes found stretching across roads. These latter are usually on very high poles or from the tops of tall trees. It is usually considered advisable in crossing wires to pull the wires down, and, when the winch has passed over them, to fasten them up immediately. This is far better than cutting the wires and splicing them together afterwards. Sometimes, however, wires must be cut, and, if they are, they should be immediately repaired. Often it will be necessary to maneuver the balloon over wires rather than to cut them or let them down, but the first two methods are better if the number of wires is not too great. In maneuvering the balloon over wires, use can be made of the tender in conjunction with the winch, or the maneuvering ropes thrown over the obstacles one by one, and the balloon slowly worked over in that manner.

With reference to maneuvering around trees, the height of the trees must be considered, their proximity to the road, the extent to which branches reach over the road, and the velocity and direction of the wind. The maneuvering spider can usually be employed to very good advantage in passing trees. Trees may often be maneuvered around by what is known as "jockeying." This consists of taking the opportunity, when the balloon swings back and forth in the wind, of catching it at the right angle and driving quickly past the tree. Most trees, however, can be passed by running the winch on the windward side of the road and by the use of the maneuvering spider. Occasionally the balloon can be put up 100 meters higher than it is usually transported and then hauled down rapidly. This straightens out the cable and to some extent overcomes the action of the wind on the balloon by the rapid descent. If at the same time the winch moves, the obstacle can be passed.

In passing through villages, practically the same means can be used as in traveling along roads bordered with trees. The usual maneuvering height of a balloon is about 100 meters. This, of course, varies with the wind.

Roads should be reconnoitered before the march, so that the best routes can be picked.

317. In maneuvering with the balloon inflated, the train should be made up as follows:

(a) Light truck ahead carrying telephone material and personnel.
(b) Winch, with winch crew, maneuvering officer, and the balloon.
(c) The tender, transporting men of the maneuvering squad, and machine guns.
(d) The remainder of the trucks, in whatever order is deemed best by the company commander.
DAYLIGHT BALLOON ATTACK
318. It is always more desirable to move by day than by night, but often, owing to exigencies of the service, it becomes necessary to make night marches. If this becomes necessary, a reconnaissance of the road by daylight is imperative. If it is possible to choose the time of marching, the early morning or the early evening are usually best, as there is often a lull in the wind at these times.

CHAPTER V.—COMBAT.

319. Combat principles.—(a) Duties of company commander: In addition to his regular administrative duties, the company commander must be responsible for the proper use of the balloon, its defense, its marches, choosing of new sites, reconnaissance of roads, liaison with units with which he is working, communications, and supplies. He is assisted in the execution of these duties by the various officers within the company, but he himself is responsible for their proper accomplishment.

(b) Duties of maneuvering officer: The maneuvering officer, under the supervision of the company commander, has complete charge of the balloon and its accessories, the protection squad, and the winch. He is responsible for the proper safeguarding of the balloon against attack, for the proper posting of means of defense, for the safety of the observers, and for the housing and precautions against observation of his balloon.

(c) Protection against attack: Machine guns and automatic cannon should be so placed near the point of ascension as to give the best barrage against an attacking plane. Lookouts should be posted at the most advantageous points from which they can scan the sky. They should be close enough to the ascension point, however, to permit of a clear transmission of warning by word of mouth.

(d) Liaison: Group commanders and company commanders should strive at all times to be in perfect liaison with the heavier-than-air units in their sector, the commanding officers of units with which the companies are working and the various sections of the general staff of corps and divisions. This is of the utmost importance.

(e) Combat orders should be issued by group commanders to their balloons. These orders should conform to the combat orders of the corps and divisions. They should assign duties, and prescribe routes of movement, either forward or rearward.

(f) Army balloon wing commanders are responsible for the reconnaissance of all roads in their sectors. Maps should be published showing all roads possible for balloons. They should confer with signal officers of units in the army and arrange so that no overhead wire crosses roads marked on the map as “Balloon Roads.” They should see to the placing of signs, such as “Balloon Road—No Overhead Wires,” on all roads in the army sector over which balloons may have to pass.

320. Offensive combat.—During offensive combat, companies assigned to divisions move with the troops of the division. The liaison officer at the divisional P. C. transmits information and orders to the company commander relative to movements. In order to assure a place in the line of march in advance, the balloon company should be attached to a neighboring artillery unit, and move with it. The details of routes and positions are, of course, decided upon before the advance takes place.

Being in a position, with liability to move forward, in addition to the regular net of telephone lines, a forward line should be run and a forward telephone central established. The line should be run as far forward as possible, and the advance central placed so that it will be convenient to the next step contemplated. This facilitates uninterrupted telephone communication with units with which the balloon is working.

321. Defensive combat.—In a defensive sector, all roads to the rear should be reconnoitered and routes established by each company commander. On days when the balloon can not ascend, the personnel of the company should be utilized to construct balloon beds and positions at intervals along the line of retirement as far to the rear as time permits.

As in an advance, telephone lines should be run to the rear, a rear central established, and as many telephone preparations as possible made for successive rearward positions.

322. Fight combat.—Balloons can not do a great deal of work at night. They are able to see flares, signals, etc., but locations can not ordinarily be accurately determined. By means of an electric signalling device, messages can be sent from balloons to front-line positions and to the rear. Balloons can be used also as a receiving point for messages.

CHAPTER VI.—ARTILLERY ADJUSTMENTS.

323. To insure efficient cooperation with artillery for the regulation of fire, balloon observers should meet with the artillery officers each evening for the purpose of securing detailed information concerning the batteries which will fire the following day and the targets which they will engage. It is a general rule that the evening conference should arrange to divide the observation so that balloons will observe fire for all targets which can be seen from balloons. All other targets will have the fire regulated by the airplanes of an observation squadron. When personal liaison of this kind is impossible the information from the artillery should be obtained by telephone.

324. The balloon observers should know in advance the following:

- Coordinates of targets.
- Batteries which will fire.
- Caliber and number of pieces to fire.
- Nature of fire (salvo or one piece at a time).
- Type of projectiles with time of flight and type of fuse.
- Interval between shots.

After securing information concerning the targets, the observer should then procure the firing maps and photographs covering the target area.

325. Adjustments are reported on the line battery target. Distances are reported in meters to the "right," "left," "over," and "short," stating first the deflection, followed by the range, thus, "25 right," "50 over." Figures are given by their digits, i.e., "two five right," "five zero." The telephone communication between
CHART SHOWING
FUNCTIONS of DIFFERENT
BRANCHES of AIR SERVICE

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balloon and battery should conform to the following example:

Battery. "Battery ready to fire."
Observer. "Ready to observe."
Battery. "No. 1 on the way, etc."
"No. 2 on the way, etc."
Observer. "No. 1 two five right, etc."

326. Shots should be reported "lost" if not seen, but reported as "not in position to observe" when the movement of the basket, a passing cloud, or other obstacle prevents a proper view of the target. When a salvo is reported "lost" by an observer, the artillery fires the next salvo with data intermediate between that and the last salvo seen and the one lost, but if the report is "not in a position to observe," the salvo is repeated with the same data.

327. In order to observe successfully for several batteries simultaneously, it is necessary to have very efficient fire and telephone discipline; also to know accurately which batteries are to fire.